THE

JOURNAL OF COMPARATIVE PATHOLOGY AND THERAPEUTICS

EDITED BY

J. M'FADYEAN, M.B., B.Sc., F.R.S.E.
ROYAL VETERINARY COLLEGE, LONDON

VOL. XII.

W. & A. K. JOHNSTON
EDINBURGH AND LONDON

1899

THE

JOURNAL OF

COMPARATIVE PATHOLOGY

AND

THERAPEUTICS.

TUBERCULIN.

Members of the Veterinary Profession may obtain Tuberculin of guaranteed quality at a charge of 6d. per dose (minimum quantity, two doses), on application to the Principal, Royal Veterinary College, Camden Town, London, N.W.

accustomed to the strange place and attendants, and to make sure that the dog or cat has a good appetite and is feeding well. If there is fever, catarrh, or other sign of ill health, the operation, unless the case is an urgent one, should be postponed. The action of the bowels and kidneys should be watched, and if the former are at all constipated a dose of laxative medicine about twenty-four hours, or an enema about two hours, before operating, is a wise precaution. The laxative chosen, however, should not be one which will cause nausea, griping, or loss of appetite. Castor oil or liquorice are suitable, and for the enema either warm water and soap or glycerine and water answer the purpose well.

Immediately before some operations it is necessary to repeat the enema, and to withdraw the urine where possible by the aid of a catheter. A light meal of finely divided solid food or a quantity of milk is advisable about two or three hours before anæsthetisation.

Vomition during, or when recovering from, the application of chloroform, so frequently met with in human patients under similar conditions, is very rare in the dog and cat. The author has only met with it in eight or ten instances out of more than a thousand chloroformisations.

After an operation under anæsthesia the patient should be put in a quiet place where there is plenty of fresh air, and allowed to recover. The eyes, nostrils, and mouth should be sponged with cold water, care being taken that none of it gets into the back of the mouth. On no account should stimulants or other fluids be administered in any quantity down the throat until recovery has taken place, as some of it is likely to find its way into the trachea and lungs. When the animal is able to lap voluntarily, a little cold water may be allowed, but solid food should not be given for at least an hour. A clean place, attention to hygiene and dietary, together with antiseptic dressings as often as necessary, will complete the directions to bring about restoration to health.

Preparatory Treatment of the Site of Incision.

All hair from this and the contiguous parts should be removed a short time before operating, by the aid of scissors or clipping machines and a razor, the skin being carefully cleansed with soap and water and thoroughly disinfected. Before an abdominal operation, or a serious one of that nature, it is always a good plan, in addition, to lightly scrub the parts with ether, in order to remove all grease. A pad of wadding soaked in some antiseptic, and carefully kept in position over the site for an hour before the operation commences, completes the process by which the parts are rendered aseptic.

If this cannot be applied, owing to the situation of the wound, the temper of the animal, or some other cause, the antiseptic chosen must be applied with great thoroughness and care at the time of operating.

The choice of an antiseptic must rest with the operator. Probably those which are in most common and general use for surgical purposes are solutions of carbolic acid, lysol, creolin (each of which are used in from 1 to 4 per cent. solutions with water), corrosive sublimate (1 in 1000 parts), chinosol (1 in 1000 to 1 in 500), boracic acid (5 to 10 grains to the ounce), and biniodide of mercury (1 in 1000, solution being aided by the addition of a little more than an equal amount of potassium iodide).

Of these, boracic acid is particularly selected for wounds on the cornea of the eye; solution of carbolic acid must be used with the greatest care when operating on small dogs or cats, as toxic symptoms sometimes ensue even when this drug is applied only to a small area.[1] Solution of biniodide of mercury has advantages over that of the perchloride, in that no precipitate is formed when it becomes mixed with blood, and it does not combine with albumen. Many of these antiseptics can now be purchased in the convenient form of soloids, one of which dissolved in a certain quantity (usually a pint or a quart) makes a lotion of the requisite strength in a few moments.

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 361.

Methods of Securing.

In securing canine or feline patients the principal objects of the operator are to place the patient in the safest and best possible position for the operation to be done, and at the same time to ensure the minimum amount of risk for his assistants and himself. Especial care on behalf of the operator or his assistants must always be taken where an animal is known to be vicious, and on behalf of the patient when the latter is known to be nervous, fat, or aged, particularly in those breeds (such as pugs, bull-dogs, Blenheim spaniels, etc.) where the nasal bones are short and depressed. With a quiet animal the head and eyes can be examined by allowing an assistant to hold the patient while the operator lightly grips the throat between the thumb and the forefinger of the one hand, pushing them firmly under the angles of the jaws, the other hand being placed on the top of the head;

FIG. 1.
Photograph of dog held as described.

all attempts at biting are thus prevented by pressing the head and jaws between the two hands. When the animal is at all inclined to be vicious, the best plan to adopt is to request the owner to grip the patient firmly by the back of the neck, whilst the operator places a tape round the jaws in such a manner as to keep them tightly closed. This tape is best affixed in the form of the clove hitch, having the loose ends underneath, and afterwards passing them under the ears to tie in a bow at the back of the poll.

These loose ends should not be tied round the neck or throat on account of the danger of strangulation. Another method of securing the mouth is to pass the tape twice round the jaws and tie once on the top of the nasal bones, twisting the two loose ends several times round one another and fixing them to a leather collar previously placed around the neck.

The clove hitch, however, is undoubtedly the superior method, as it is very easy to apply, effectually keeps the jaws closed, and can be removed at a moment's notice by simply applying traction to either one end or the other. The method by which it is made is

Fig. 2.

A clove hitch applied.

difficult to describe, although it can be readily demonstrated with a piece of cord or tape. Two loops are made in reverse directions and folded on each other so that they fall as illustrated in Fig. 4.

Having thus prevented the animal from biting, the next step is to fix the patient in such a position as will be most convenient for the

Fig. 3.

Showing tape applied as above.

performance of the operation, and at the same time give the minimum amount of risk of injury. For minor operations, such as lancing of some abscesses, etc., all that is necessary is to get an assistant to hold the dog or cat, but for prolonged or delicate operations it is always

best to secure the animal by the aid of hobbles or a proper operating table.

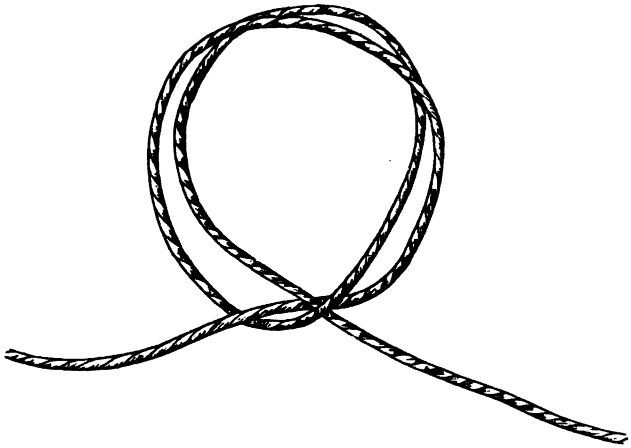


FIG. 4.
A clove hitch ready for application.

Portable hobbles are made, consisting of clamps which can be placed anywhere on the edge of an ordinary kitchen or saddle-room

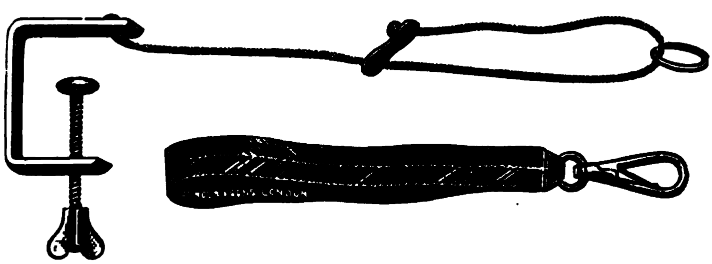


FIG. 5.
The author's pattern of hobble.

table, a tape to pass round each leg, and adjustable sliding cords by which the length may be graduated as much as is thought requisite.

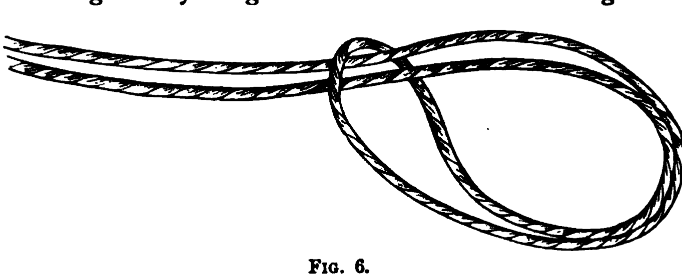


FIG. 6.
Improvised hobble.

Hobbles can be improvised by doubling four long pieces of tape in each case so as to make a slip noose in the centre, and then fixing

the loose ends to the legs of an ordinary kitchen or saddle-room table, or to nails or hooks driven in the edge of the table.

An operation table is almost essential in every large canine practice, and even where only a moderate amount of canine work is done its advantages cannot be over-estimated. The top should be made of

FIG. 7.
The author's pattern of operation table.

some hard wood, such as pitch pine, teak, etc., which will bear constant washing without tendency to shrink, and should consist of a board about 1 inch thick. If expense were not a consideration, it would be better for antiseptic reasons if it were made of metal or some such absolutely impermeable material. The measurements of the top,

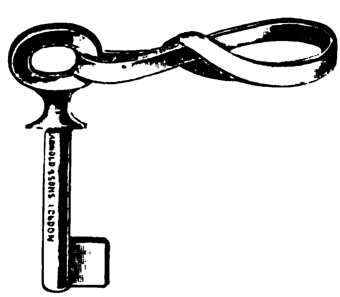


FIG. 8.
Key hobble looped ready for application.

to take all classes of dogs, are about $5\frac{1}{2} \times 2\frac{1}{2}$ feet. The front is improved by making the edge in the form of a semicircle, as this sometimes affords an advantage when operating upon the parts which overhang it. The keyholes are placed in parallel rows at intervals of about 3 inches, the long part of the hole being made to point

towards the centre of the table, as shown in the diagram. The keys, which fit into these holes, are made of brass or other metal, being shaped like a solid key, but having a shoulder or rim running just underneath the loop in order to prevent them from passing too far into the hole in the board. The hobble consists simply of a piece

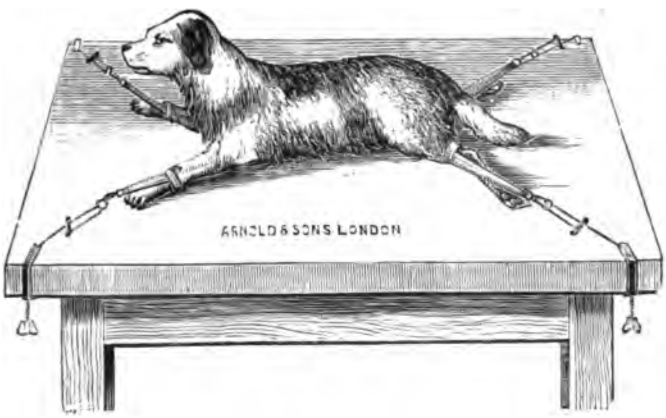


FIG. 9.
Diagram of dog fixed with hobbles on an ordinary table in the "abdominal" position.

of tape passing through the ring on the key, the two ends being stitched firmly together.

The method of securing an animal is to first place the clove hitch on the jaws as previously described, then a hobble tightly round each leg (in the fore leg above the carpus and in the hind legs above the tarsus); secure the fore legs first by passing the keys through two of the holes in the table and giving them a twist, then the hind

FIG. 10.
Photograph showing animal fixed on the operating table in the "dorsal" position.

hobbles in the same way, pulling the hind legs down together. With very large dogs it is sometimes also a good plan to pass a piece of stout webbing over the back and loins and tie it under the table. The chief precaution to take is to see that the legs are just sufficiently wide apart and well stretched out to allow of no violent struggling.

When the hobbling is done properly it is astonishing with what ease an animal can be controlled. This places the patient flat on its abdomen, and for convenience will be referred to, when speaking of positions for operative purposes, as the "abdominal" one.

When it is necessary to operate upon the abdomen or under parts of the body the animal is turned upon its back and fixed in a similar way, extra care, however, being here taken with the fore limbs, so as not to stretch them out too tightly and thus injure the muscles attaching the fore limb to the chest. This will for descriptive purposes be termed the "dorsal" position.

For operations on the sides or flank the animal can readily be laid on either side. These will be referred to in the text as the right and left "lateral" positions respectively.

Since this pattern of table has been introduced into the Free Outpatients' Clinique more than 4000 animals have been secured in one or other of the above-mentioned positions without accident.

Another pattern of operating table has been recently devised and described by Mr B. P. Godfray,[1] M.R.C.V.S., in which the legs are secured by tape hobbles to the ends of the table, but in addition the body is held in position by three straps which pass through slits in the table surface and are buckled round the neck, chest, and loins respectively.

The Administration of Anæsthetics (Local and General).

Anæsthetics are medicinal agents which produce unconsciousness to pain, and they are used for this purpose very largely when performing operations. They are of very great value on humane grounds, and also on account of the convenience they afford to the operator. They cause relaxation of muscular tissues in some cases (such as herniæ), and allow delicate operations to be conducted with much greater care and precision, when the animal is perfectly still, than could be adopted with a struggling, violent patient. They are divided into two classes, viz., local and general.

By the term "local" anæsthetic is understood "an agent which removes sensation from the parts to which, or contiguous to which, it is applied."

Under this heading, for surgical use, come such agents as cold water, ice, ether, ethyl-chloride, cocaine, eucaine, holocain, and orthoform.

By the term "general" anæsthetic is understood "a medicinal agent which acts upon the higher centres to produce a complete loss of consciousness in the whole body of the animal to which it is administered."

Under this heading, for surgical use, come such preparations as chloroform, ether, the A.C.E. and other mixtures.

Taking the local anæsthetics first, anæsthesia produced by the first four agents mentioned (viz., cold water, ice, ether, and ethyl-chloride) depends chiefly upon the amount and intensity of the cold produced.

Cold water and ice have a very transient effect and are only suitable for trivial operations, such as the lancing of abscesses, or the removal of small superficial tumours. In order to act efficiently they must be applied for a few minutes directly to the part upon which the operation is to be performed.

[1] "Veterinarian," December 1896.

In ether and ethyl-chloride we have drugs by the aid of which the parts are artificially frozen and thus deprived of sensation. Ether is applied with a spray as first introduced into human medical practice by the late Sir W. B. Richardson, M.D.

The parts to be anæsthetised should have the hair removed by shaving and be then rendered aseptic and as dry as possible, the ether

FIG. 11.

Ether spray apparatus.

being forced out of the bottle by the rubber bellows, and falling directly in the form of a very fine spray on the required spot.

Ethyl chloride, which is also applied in the form of a spray, is sold in a very portable and neat form in small glass or metal vessels.

It is applied directly to the spot at which anæsthesia is to be produced by merely removing the metal cap from the end and holding the bottle in the warm hand.

These two agents are also best suited for minor operations, such as the lancing of abscesses, the anæsthetising of the skin, or the removal of small superficial tumours, and are not readily applied to thick muscular tissues where a considerable amount of dissection has to be

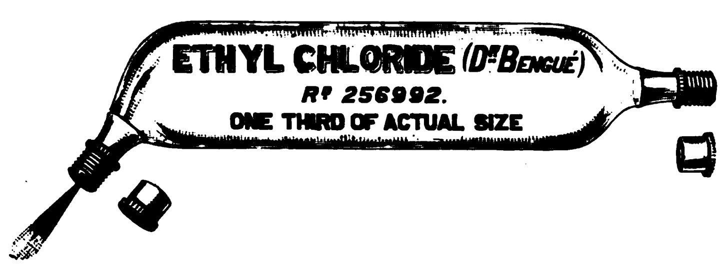


FIG. 12.

Glass tube containing ethyl chloride ready for application.

done; the reasons being that if a thin layer only be frozen the warm blood (when the incision is made) prevents the further application of the anæsthetic, whilst if the whole mass be frozen first it is difficult to cut, and there is the danger of necrosis as a sequel.

As a general rule anæsthesia is produced when the skin has turned

white; this occurs in from half a minute to a minute and a half, and the effect lasts for about two minutes.[1] Care must be taken not to keep the parts frozen for too long a time, or necrosis may follow.

The above-mentioned agents have the advantage over other drugs of not being in any way absorbed so as to produce toxic effects unless inhaled through the respiratory passages, and even in that case plenty of warning would be given by the patient.

For operations on the cornea of the eye they are not suitable on account of the amount of irritation set up.

We now come to cocaine, eucaine, holocaine, and orthoform, which owe their special function to their power of paralysing nerve terminals in the tissues to which they are applied.

Cocaine is a vegetable alkaloid obtained from the leaves of the coca plant, whilst eucaine is a chemical preparation possessing exactly the same formula.

The hydrochlorate of each is the salt generally made use of.

Both of them are toxic, even in very small doses, and great care has to be exercised in their use; they are readily absorbed into the system from subcutaneous, serous, or mucous surfaces, particularly from the first named.

Cocaine hydrochlorate is readily soluble in cold or warm water, but decomposes on boiling; the solutions made use of vary from 1 to 10 per cent. It should always be made fresh when required, as even after a few days the efficacy of the solution is not to be relied upon. If it is absolutely necessary to keep it in solution a small quantity of either salicylic or boracic acid added to it will help to preserve it for a longer time.

After an injection complete local anæsthesia is produced in from three to five minutes, and lasts about twenty or twenty-five minutes; its effect is manifested around the seat of injection for a space of from half-an-inch to an inch-and-a-half, so that where a large tumour is concerned injections must be made in several places. Superficially it can be used to deaden pain when painted on parts (such as the under surface of the abdomen and thighs) where the skin is thin, but on the thicker parts its external use on the unbroken skin is not encouraging. On the cornea of the eye its effect is splendidly shown in from one to three minutes.

Eucaine hydrochlorate, when used alone, does not give such good or rapid anæsthetic results as cocaine, except when applied to the cornea of the eye. It is, however, slightly cheaper than cocaine, a solution of it can be boiled and thus rendered sterile without altering its anæsthetic power, and the toxic dose is a little larger. When anæsthesia is produced, too, the effect lasts longer than that of cocaine. A mixture of the two in equal proportions is very useful, as by it can be produced the better and more rapid anæsthetic effect of the cocaine, and at the same time the more prolonged anæsthesia and greater security from toxic symptoms which follow the use of eucaine. In order to be on the safe side, the operator should never allow of either cocaine or eucaine more than one-tenth of a grain for each pound of the live body-weight of the patient to be absorbed into the system at one time.[2]

[1] "Journal of Comparative Pathology and Therapeutics," Vol. IX., p. 227.
[2] Idem, Vol. VIII., p. 20; Vol. X., p. 80.

Holocaine,[1] like eucaine, is a chemical preparation and is used in the form of the hydrochlorate. It is antiseptic and does not decompose on boiling. A few drops of a 1 per cent. solution cause, when applied to the cornea of the eye, a temporary burning sensation, which passes off in a few seconds and is immediately followed by a local anæsthesia lasting from about twelve to fifteen minutes. It is not suitable for hypodermic injection or for use over any extent of surface, as it is more toxic than cocaine, producing symptoms resembling those of strychnine. The chief advantage which it is claimed to possess over cocaine or eucaine is that local anæsthesia is produced in ophthalmic cases without causing any intraocular tension or congestion of vessels in the neighbourhood to which it is applied.

Orthoform,[2] a local anæsthetic which has been introduced within the past eighteen months, is very valuable for wounds, mucous surfaces, and places where the skin is abraded. From a canine surgical point of view it is mainly of value in the treatment of wounds that are painful, and, dissolved in collodion in the proportion of 1 to 8, as an application for hermetically sealing an operation wound. For the latter purpose it is most valuable, especially for the closing of such wounds as are made during an abdominal operation. Before application, after the sutures have been inserted, the wound is thoroughly dried and the mixture painted on with a camel hair brush. Its local anæsthetic effect is well marked, and continues for periods lasting even as long as thirty-six hours; in addition, orthoform is non-poisonous and can be used over large abraded surfaces with perfect safety. In the Clinique we have used it at least thirty times in the dog or cat as an application after laparotomy without bandaging, and in no case has the animal evinced irritation or attempted to interfere with the sutures; in other instances of painful wounds, too, orthoform has proved equally valuable, when used alone or mixed in varying proportions with starch or boracic acid.

Having thus disposed of the local, we have next to consider the general, anæsthetics, *i.e.*, those which produce complete loss of consciousness in the whole of the body by their action upon the higher cerebral centres. Of these the best are chloroform, ether, and the A.C.E. and A.E.C. mixtures. They are used for major operations, and in cases, such as reduction of herniæ, where it is desirable to relax various tissues.

The Choice of the Anæsthetic.

Chloroform is by far the most ideal anæsthetic to choose for the average adult animal. It is much more pleasant to taste than ether, does not produce so much salivation, the stage of excitement is less, and that of anæsthesia more prolonged, besides which the after nauseating effects are by no means so well marked. If given slowly and properly diluted the risk to adult canine patients is very slight. In the cat, however, and in the young of very delicate breeds of dogs, greater care must be exercised, and it is safer to choose either ether or the A.C.E. mixture. The last named consists of a

[1] "British Medical Journal Epitome," 1898, p. 99; "Year Book of Treatment for 1898," pp. 158, 368, 454.
[2] "British Medical Journal Epitome," 1898, p. 79; "Lancet," 6th Nov. 1897.

mixture of 1 part of alcohol, 2 parts of chloroform, and 3 parts of ether. These opinions are based on the fact that (mainly in the Out-patients' Free Clinique of the College) chloroform has been administered within the past five years, by the pattern of inhaler shown in Fig. 14, to more than 600 consecutive canine patients with only three fatalities, two of which were satisfactorily accounted for on *post-mortem* examination; in the third case unfortunately no *post-mortem* was made. As, however, the latter was a pug I was not altogether surprised, this breed of dog being usually risky to anæsthetise on account of the shape of the nose. The operations were of all kinds, some very trivial and some very severe, the animals not being (except in a very few instances) in any way prepared or selected, of all ages, sizes, breeds, and conditions. The periods of anæsthesia varied from a few minutes to four hours.[1] Of the three fatalities two patients were pugs and the other an aged fox terrier; the latter was found to be the subject of a generalised tuberculosis which involved very extensively both the heart and pericardium. In the case of the first pug the animal was very old and very nervous, and death was due to rupture of a large abdominal vessel whilst struggling in the stage of excitement. In cats 120 consecutive cases were chloroformed with three deaths—a much larger proportion. Since these experiences we have used A.C.E. mixture or ether for all short-nosed delicate breeds of dog and for cats, up to the present without a fatality out of about eighty cases.

Contra-Indications to the Use of General Anæsthetics.

Extra care must always be exercised in very young animals, those of delicate breeds, those which are very fat, and those suffering from any respiratory or cardiac trouble.

Any impediment to the respiratory functions must always be looked upon with especial caution; with regard to some cardiac affections, it is worth noting that in five or six instances in the Clinique, dogs, whose *post-mortem* examinations, when made shortly afterwards, revealed large vegetations on the valves of the heart, had taken chloroform for a prolonged period without showing the slightest sign of danger.

Preparation of the Patient.

It is a good plan, although by no means absolutely essential, to diet the animal carefully for one or two days, and to allow only a small meal about two hours previous to the administration of the anæsthetic.

It is not necessary to make use, as is sometimes recommended, of subcutaneous injections of atropine or morphia a short time before anæsthetising, or to administer either ammoniacal or alcoholic stimulants. In fact, from observations made in order to test this point, the author is inclined to consider that when morphia and atropine (or either) are previously used, the result is rather to increase than diminish the risk.

[1] "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 287; Vol. XI., p. 114; "Veterinary Record," Vol. IX., p. 284; Vol. X., p. 163.

Method of Fixation.

The object in fixing must be to place the animal in such a manner, first, that the organs contained in the thorax are allowed full play, and secondly, that relief from restraint can be effected at a moment's notice. These points are very important, and, in fact, absolutely essential.

The safest position is undoubtedly that which is described in the chapter on methods of securing as the "abdominal" one, the patient being anæsthetised in this position, and afterwards turned about as required to suit the convenience of the operator.

If the animal is merely held in the arms of an assistant, care must be taken not to in any way compress the chest or hinder the breathing during the stage of struggling which usually precedes anæsthesia.

Methods of Administration, Apparatus, etc.

There are two chief methods of administering general anæsthetics. One is known as the "open" method, and the other "administration by the aid of an inhaler."

For the "open" method, the best and safest results can be attained by the aid of an ordinary wire muzzle, a thin duster, and a drop bottle; or, in place of the duster, a piece of thin flannel or calico may be

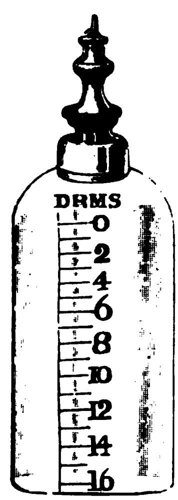


FIG. 13.

Diagram of drop bottle.

previously sewn around that part of the patient's muzzle which covers the nostrils and lips.

The great secret of success with chloroform is to allow plenty of air, and only just a sufficiency of well diluted chloroform vapour for the purpose required. The duster must on no account be folded upon itself, one thickness of the cloth being ample, and the anæsthetic applied *gradually* from the drop bottle.

The wire muzzle is useful, because it forms a framework upon which to rest the duster, and protects the face from the irritant effects of any

chloroform which would otherwise come in contact with the skin or eyes. For small animals an improvised apparatus can be made by placing a piece of blotting paper or cotton wool soaked in chloroform at the bottom of a tumbler or gallipot, and holding it over the animal's nose; or the animal may be placed under a bell jar, or in an air-tight box with a glass lid, into which there is placed some material soaked in the anæsthetic.

The two latter methods, however, require great care, and are not very convenient for prolonged operations.

The inhalers suitable for canine work are of three patterns, varying somewhat in their construction and in the amount of vapour which they give off.

The advantages of an inhaler are, that only the vapour comes in contact with the patient's nostrils (there being thus no fear of irritant effects), the anæsthetic is well mixed with air in tolerably constant proportions before being breathed, the amount allowed can be adjusted with great delicacy, and the risk of overdose is thus minimised; the quantity, too, of chloroform used is considerably less, as the amount wasted is exceedingly small.

The first apparatus is so devised that it allows six or eight drachms of chloroform to be placed in the bottle; by means of the bellows a current of air is sucked over the surface of the anæsthetic, the mixed vapour being forced onwards into the mask.

FIG. 14.

Diagram of author's anæsthetic inhaler (first pattern).

When eight drachms are in the bottle and the temperature of the air about 60° Fahrenheit, each full compression of the bellows sends over chloroform vapour well mixed with air in the proportion of about 1 in 2500. In order to produce anæsthesia, the bellows must be worked as hard as possible, the end of the mask being closed at the discretion of the anæsthetist.

With strong dogs of the larger breeds it is sometimes necessary to assist anæsthesia by placing a little chloroform on wadding in the end of the mask. For very delicate or young animals the vapour can be very much more diluted, either by putting less chloroform in the

bottle, by only partially compressing the ball, by regulating the amount admitted by means of the tap, or by leaving the end of the mask uncovered.

The second pattern, known as Junker's, which has been modified to suit the smaller animals by Messrs Kröhne and Seseman, allows a stream of air to be forced through a quantity of chloroform, and so sends into the mask the vapour of air and chloroform mixed.

FIG. 15.

Diagram of Junker's inhaler (Kröhne and Seseman's pattern).

With this it has been estimated that (at a temperature of 62° Fah.) with eight drachms of chloroform in the bottle, each full compression of the bellows sends over an average of one minim of chloroform vapour well mixed with air, in the proportion of 1·869 per cent. This apparatus is suitable for large dogs, but with small ones and cats great care must be exercised, or an overdose may easily be given. When used for these animals the bellows must not be compressed to their fullest extent, and the end of the mask must be left open.

The anæsthetist should commence by pressing the ball very lightly, and not to more than about one-sixth of its extent, the pressure being gradually increased until sufficient vapour has been given to produce anæsthesia.

The third pattern of apparatus plays a medium part between the other two, as its object is to force a current of air over the surface of the chloroform.

The vapour sent over is stronger than that of the first pattern, but less concentrated than that of Junker's.

Another modification, suitable for hospitals or infirmaries where operations are constantly being performed, consists in an arrangement whereby all pumping by means of the bellows is done away with, a cylinder of compressed air with a regulating valve being attached to the bottle in such a way that the current (when turned on) passes either over or through the chloroform, and so forces the mixed vapour onwards into the mask.

Whichever inhaler is used, care must be taken to produce anæsthesia slowly, and to administer the vapour as regularly and steadily as

FIG. 16.
Diagram of author's second design of inhaler.

possible. The average length of time required in which to produce the safe stage of unconsciousness for a cat or small dog is from one to

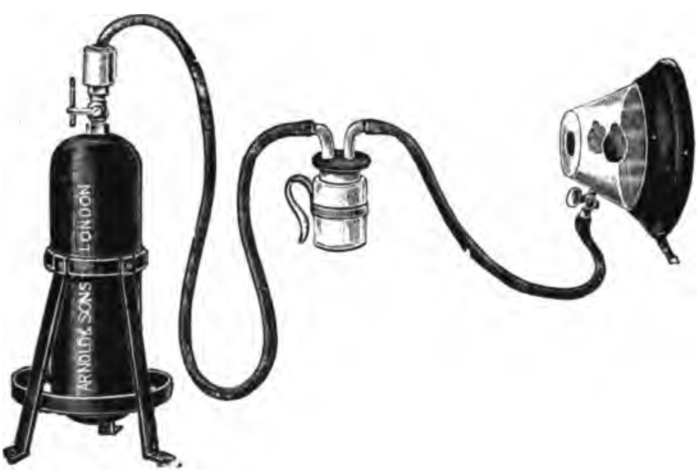


FIG. 17.
Diagram of author's third pattern of inhaler showing another form of mask.

two minutes; for a dog the size of a terrier, about three or four minutes; and for the larger breeds, six or eight minutes.

Stages of Anæsthesia.

During the process of complete anæsthetisation an animal passes through four stages. The first one is a stage of surprise and alarm, during which the patient sometimes holds its breath as if unwilling

to receive the strong vapour. This is especially noticeable in cats and rabbits, and care must be taken to allow the respirations to become regular before proceeding. The second stage is one of excitement, during which the animal is in a semi-conscious state, and appears in an almost frenzied condition, yelping and struggling violently, and often involuntarily relaxing the sphincters of the rectum and bladder. After this we get the third or safe anæsthetic stage, in which the animal is ready for the operation ; and lastly, the fourth or dangerous stage, in which there is risk of permanently paralysing one or more of the great vital centres. When the anæsthetic is administered very gradually it is often possible to cause the animal to pass into the third stage without becoming in any way frenzied or excited ; one can frequently succeed in quietly anæsthetising small dogs whilst they are held in the arms of the owner without being secured in any way and without any struggling, the animal passing tranquilly into the stage of unconsciousness.

The first signs of the approach of the stage of safe anæsthesia are that the struggling becomes less, the efforts being weaker, and the tail becomes limp; then the hind quarters become powerless, and ultimately the head cannot be raised. When the whole body is totally limp and respirations are regular the operation should be performed. Dilatation of the pupil of the eye, especially in the cat, is always well marked, and is by no means, as stated by some, a sign of danger. To maintain the patient in this stage with safety the anæsthetic must be carefully administered in small quantities from time to time at discretion, and it is a good plan to release the animal from restraint as much as possible in order to be thoroughly prepared to administer antidotes in case of accidents. An animal may be kept in this stage for any reasonable length of time. In the College Clinique the longest period in which we have kept a dog under chloroform has been four hours, but very few of the operations of daily practice require an anæsthesia of more than half-an-hour.

The anæsthetist must devote his whole time and attention to his work, and not be watching the operator. He must note particularly the efforts of respiration ; should these become weak, shallow, irregular, or in any way spasmodic, or should they cease suddenly, the mask must be at once removed and antidotal measures adopted. The pulse is not such a good guide to danger, but extra care must be taken if it becomes irregular, jerky, intermittent, or feeble. The temperature of the body must be taken into consideration in very prolonged operations; the effect of the anæsthetic, combined with the stillness of the body, causing a fall below normal. This should never be allowed to get below 95° Fahr. Another sign which is dangerous is a convulsive twitching of the extremities, especially marked in the paws of the hind legs, and in the cat it invariably means death if the hairs of the coat suddenly turn the wrong way.

The respiration, however, is the chief and also the easiest thing to watch. Out of an experience of a very large number of dogs and cats destroyed with chloroform gradually administered, in fully 95 per cent. the respiration has perceptibly been the first to fail. Occasionally the heart has appeared to cease first, or the two have appeared to stop together, these being particularly noticed when the vapour was rapidly administered in a concentrated form and insufficiently diluted

with air.[1] The phonendoscope, an instrument devised particularly for listening to chest sounds, is of great service in demonstrating these points.

Remedial Measures and Antidotes.

In all cases where general anæsthesia is practised antidotes should be placed beforehand in a position where they can be obtained and used at a moment's notice.

Upon the first signs of danger at once tear off the mask and remove all restraint; carry the patient carefully into the fresh, cool air, place in a horizontal position, lowering the head slightly in such a way that the lumen of the trachea is not at all lessened; open the mouth, withdraw the tongue, either with the fingers or forceps, continually pulling it forward in a jerky manner; apply some medicinal antidote and immediately commence artificial respiration.

The latter can be done in several ways. We may copy the method known in human practice as Sylvester's, which consists in placing the patient on its back and slowly endeavouring to imitate normal respiratory movements by extending the fore limbs well over the head, and then pressing the elbows and bent limbs against the sides of the thorax.

A second, which appears to bring greater success in the dog and cat, consists in laying the animal on the right side and emptying the thorax by means of a number of short, sharp efforts, the natural elasticity of the ribs causing the chest to again expand.

Whichever way is adopted, the mouth at the same time should be held open and the tongue drawn well forward by short, sharp jerks, in order to raise the larynx and allow as free a passage as possible for the entrance and exit of air.

A third method which will cause the lungs to be filled is performed by taking hold of each elbow and jerking the body upwards into the air several times. This is certainly a very effective method of filling the thorax, but there is always danger of rupturing some large abdominal vessel in fat animals, and in the large and weightier breeds it cannot always be managed.

A fourth method which sometimes brings success is to force air or stimulant vapour (such as that of amyl nitrite) by means of a special form of bellows (Higginson's enema syringe can be improvised for the purpose) up the nostrils and so into the lungs. This is done in a jerky manner and the air is then forced out again with a succession of short, sharp compressions on the ribs.

In practising any of these ways care must be exercised, as rupture of the liver or mesenteric artery is an occasional sequel to performing artificial respiration too energetically, especially in fat and aged animals.

Recovery will sometimes follow simple inversion or swinging the animal round by the hind legs, these acts being performed with the idea of causing a flow of blood to the head and thus relieving the over-congested heart. These methods are, however, open to the objection that they tend to diminish the capacity of the chest by throwing the weight of the abdominal organs against the diaphragm.

[1] "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 287; Vol. XI., p. 101.

Cold affusions to the head and chest, and striking the body with a wet cloth are also recommended, but certainly must not be trusted to alone.

Tracheotomy is sometimes advisable, but in cases of this kind, where whatever is done must be done immediately, this operation is often a matter of difficulty, especially in the smaller and long-haired breeds.

Venesection has been practised but cannot be relied on.

The medicinal antidotes found to be of the most value are: strong ammonia vapour, amyl nitrite, hydrocyanic acid (Scheele's), and subcutaneous injections of ether, saline solution, or strychnine.

Whatever antidote is chosen it is obvious that the chances of success are enormously increased if the agent can be administered before respiration actually ceases. If this could always be done the proportion of deaths during anæsthetisation in the dog and cat would be infinitesimal.

Since chloroform is an agent which destroys life by paralysing either the respiratory or cardiac centres, and sometimes both apparently at once, the objects sought for in an antidote are those which will act as a stimulant and restorative to either or both. It is important then that the anæsthetist shall select the one which seems most nearly to fulfil these objects.

In ammonia vapour, such as is evolved from liq. ammon. fort., we have an agent whose therapeutic actions are those of general stimulant, both respiratory and cardiac, but we dare not give it in the form of a draught, because the patient is unable to swallow, and we cannot inject it hypodermically on account of its slowness of absorption and irritant action, whilst its intravenous injection is difficult, so that it is usually given in the form of a vapour inhalation. It is needless to remark that the respiratory apparatus must be artificially induced to work if it has ceased to do so, in order that the effect of the vapour may be shown on the body. This is sometimes a source of difficulty, and when once the respiratory organs have recommenced to work the vapour must not be too suddenly applied, or the reaction is apt to be too severe. It must be used at intervals with discretion, holding the bottle under the patient's nostrils for a few moments and then withdrawing it.

With amyl nitrite the chief action is that of a cardiac stimulant, and it has the advantages of being non-irritant and readily absorbed from mucous surfaces, so that it can be administered on the tongue. The necessary dose, too, is very small, and it can be given undiluted. For the dog or cat about one quarter of a minim for each pound body-weight is a fair average dose.

Hydrocyanic acid [1] first suggested itself as an antidote to chloroform whilst watching the powerful respiratory efforts which it so rapidly causes when given to produce toxic effects, and when used as an antidote the object must be to give just sufficient to attain a temporary stimulating effect on the respiratory centre without causing over-stimulation and consequent arrest. Its rapidity of action is unquestionable, and it can be given either subcutaneously or by the mouth. With the former there are no local irritant effects as a sequel; and with the latter there is no danger of any entering the

[1] "Journal of Comparative Pathology and Therapeutics," Vol. XI., p. 101. "Lancet," 1st Jan. 1898.

trachea and producing choking, because the dose is so small. The method of administration which is advised consists in placing a small quantity by the aid of a drop-tube on the back of the tongue, from whence it is absorbed readily by the moist mucous membrane. A full medicinal dose should be given, Scheele's acid acting quicker than that of the British Pharmacopœia strength, although, of course, it must be used with greater caution, one reason being that the evanescent vapour is drawn into the lungs by the performance of artificial respiration, and is thus more rapidly absorbed into the system. Hydrocyanic acid is of especial value because it not only stimulates the respiratory centre to re-commence if once it has ceased, but if given in full medicinal doses it maintains the efforts until they are able to look after themselves, and at the same time, by the deep inspirations produced, it causes the entrance of a large amount of

FIG. 18.
Antidote drop-tube and bottle for hydrocyanic acid.

fresh air into the system. Its effects, too, on the heart-beats is beneficial. The dose recommended, of Scheele's strength, to be placed on the tongue averages about one-eighth of a minim for each pound of body-weight. Subcutaneous injection of ether is advised on account of its rapidity of absorption and powerful action as a general and diffusible stimulant. Saline solution (one ounce of salt to the pint of distilled water) has certain action upon the blood plasma which assists the engorged and enfeebled heart to recover itself. It acts more rapidly when heated to a temperature of from about 105° to 110° F. before being injected.

Strychnine is used because it is a respiratory stimulant, but its action is decidedly slower than that of hydrocyanic acid, and besides that there is always the great risk of overdosage, as in order to get rapid antidotal action a full dose must be given, and dogs and cats seem to have most peculiar individual susceptibilities to this drug.

In the Clinique we have had opportunities of trying each of these different methods and agents, and the plan which we have found to yield the best results has been to immediately release from all restraint, clear the nostrils and throat of mucus, draw the tongue well forward in a jerky manner, apply artificial respiration by the second method described, as quickly as possible place a few drops of Scheele's hydrocyanic acid on the back of the tongue, and cautiously apply the ammonia vapour to the nostrils.

Symptoms of Recovery, etc.

After respiration has actually ceased, the good signs to be looked for when resuscitative measures are being adopted are:—

Recommencement of respiration, the efforts becoming gradually more regular; increase in force and regularity of the heart's action; side to side movements of the lower jaw and voluntary retraction of the tongue; moaning or yelping; and movements of the head, ears, or limbs.

When breathing has recommenced artificial respiration should be carefully continued until the patient is well out of danger, or, if this precaution is not followed out, the breathing may again cease and death ensue.

When an animal is recovering plenty of time should be allowed to elapse before fluid restoratives or foods are administered forcibly by the mouth, as there is danger of some of the material getting into the trachea and causing choking or pneumonia; care must also be taken, particularly when dealing with the cat, to avoid being bitten, as sometimes an animal when recovering will involuntarily make a vicious bite at any object near its mouth, and not unclose the teeth until forcibly made to do so. Bad omens are to be gathered from relaxation, during the stage of danger, of the sphincters of the bladder and rectum; erection of the hairs of the coat, especially well marked in the cat; stoppage of the heart, and no sign of returning animation after five minutes' continuous and careful attempt at resuscitation. Hope should not be given up for at least ten minutes after respiration has ceased, and above all never so long as the heart is beating. In several instances we have observed from two and a half to four minutes to elapse before there was any sign of a return to life.

In case of a fatal termination, a *post-mortem* examination should always be made where possible, as this often gives a satisfactory explanation of the cause of death.

Differences between the Administration of Chloroform, Ether, and A.C.E. Mixture.

When desirous of using ether, either by the open method or with the aid of an inhaler, air must be excluded to a very much larger extent than when chloroform is chosen.

The mixed vapour should consist of fully 70 per cent. of ether, whereas with chloroform the proportion admitted even for a large dog need not in the majority of cases be more than 1 in 1000, and for very young animals and those of the smaller and more delicate breeds 1 in 3000 or 1 in 4000 parts of air is not too small a percentage, especially at the commencement.

If using a wire muzzle and towel the latter should be folded two or

three times after the anæsthetic has been put on it and the ether allowed to flow much more rapidly from the drop bottle or measure; with an inhaler air must be excluded at the end of the mask as much as possible, always of course at the discretion of the anæsthetist. With this drug the stage of excitement is longer, and that of anæsthesia shorter, than where chloroform is used.

The A.C.E. mixture is particularly useful for small, delicate dogs and cats. With it there is not so much risk of producing dangerous symptoms as when chloroform alone is used by an inexperienced anæsthetist, and the mixture does not produce so much salivation as when ether alone is used; besides which, the stage of anæsthesia lasts longer, and that of excitement is shorter, than when ether is used. It thus occupies a middle place between chloroform and ether.

Preparation of Instruments, Drainage Tubes, Suture Material, Sponges, etc.

Before entering upon a surgical operation it is essential that the operator bestows care upon the instruments which he is about to use.

One of the most important secrets of the successful healing of a surgical wound consists in seeing that injurious germs are not introduced by means of the instruments, and it is very essential that the latter shall be first rendered aseptic. This can be readily attained by boiling for about ten minutes in some form of steriliser (for which purpose an ordinary clean saucepan or fish kettle can be suitably

Fig 19.

Instrument steriliser.

improvised), or by placing for at least half-an-hour previous to use in an antiseptic solution of reliable strength. To merely plunge them in an antiseptic solution, as is frequently done, about a minute before operating is of no value at all.

For the antiseptic solutions trays or dishes made of glass, earthenware or metal are necessary. A clean pie-dish or an enamelled iron bowl can be improvised for the purpose very well.

The solutions usually chosen are those already mentioned when

dealing with the preparation of the site of incision; most of them have some minor disadvantages although the advantages far outweigh these. For instance, solutions of carbolic acid and lysol made the handles slippery to take hold of and have an astringent effect on some operators' hands. Solutions of chinosol, biniodide of mercury, and corrosive sublimate discolour the steel; solutions of creolin are opaque and hide the instruments; and each of them has more or less action upon the edge of the blade. During the operation the greatest care must be taken that the instruments do not come in contact with anything which has not been thoroughly cleansed and rendered aseptic, and when finished with they should be carefully cleaned, dried, and put in a dry, clean place until required for future use.

Scalpels with metal handles, and forceps, scissors, etc., that take to pieces in order that the joints may be thoroughly attended to, are always preferable. The nickel-plating of parts which can be so

Fig. 20.

Instrument cabinet.

treated is also an advantage both as regards cleanliness and for the sake of appearances.

Instrument cabinets, with tight-fitting doors to exclude dust and with glass shelves, can now be obtained at a comparatively small cost, and if placed in a dry situation nothing further is necessary than to lay the instruments inside.

In the event of the absence of a proper cabinet the instruments should be wrapped in clean lint or wadding and put in a thoroughly dry and dust-proof place.

Preparation of Silk and Wire.—Silk and wire for suture purposes should be clean and carefully boiled for at least ten or fifteen minutes before use, or placed for at least half-an-hour in some antiseptic solution. Silk is conveniently prepared in various sizes known as 00, 0, 1, 2, 3, 4, etc., and can be kept ready for immediate use by being wound on glass reels and kept in glass stoppered bottles.

Catgut and Kangaroo Tendon will not bear boiling; they require lengthened immersion in antiseptic solution, and, to be thoroughly sterile, a proper method of preparation. Mr C. B. Lockwood, F.R.C.S.,[1] speaks very highly of the sterile property of catgut prepared according to Esmarch's[2] directions, which are as follows: "The ordinary commercial catgut, Nos. 1 to 3, is vigorously cleansed with a brush in soft soap and water, and after washing in pure water, is wound on glass spools and laid in bichloride of mercury solution (1 to 1000) for twelve hours; then in an alcoholic (1 to 200) solution of bichloride for twelve hours, and it is then preserved dry in tightly closed glass vessels. Just before it is used it is laid in a vessel filled with an alcoholic (1 to 2000) solution of bichloride of mercury."

Catgut, ready prepared by the above or some similar method, can be purchased at a reasonable price, being conveniently arranged in dust-proof bottles in such a way that the gut is kept in the solution until a portion of it is required, and then only that portion is exposed which is to be used.

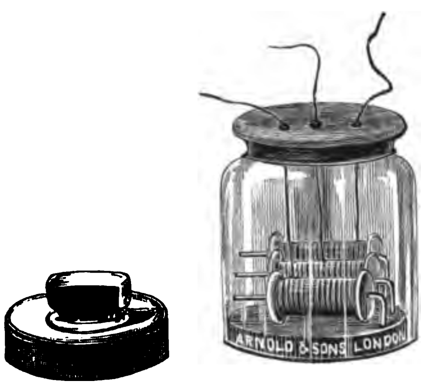


Fig. 21.

Diagram of glass ligature bottle (Clarke's).

Silkworm Gut or Fishing Gut, particularly useful for suturing the abdominal wall because of its not possessing capillary properties, is readily sterilised by boiling. It is also made in different sizes.

Drainage Tubes, either of glass, metal, or rubber, are readily sterilised by boiling and afterwards immersing them in an antiseptic solution; the chief trouble with our patients is to keep them clean when in position, and in reality the less they are used the better, a plug or tent of antiseptic cotton wool being usually an efficient substitute.

Sponges are very useful for the purpose of soaking up blood, etc., when operating, but as it necessitates a lengthy and troublesome process to cleanse and render them sterile, it is the wisest plan to avoid their use whenever it is desired that immediate union shall take place. Tampons of cotton-wool which have been boiled for about fifteen or twenty minutes and afterwards placed in a reliable antiseptic solution are much better, and as they are cheap they can be

[1] "Aseptic Surgery," p. 180.
[2] "The Surgeon's Handbook," translated by Curtis, 1888, p. 15.

used freely. They are made either by merely screwing up some cotton-wool into little balls or, better still, by stitching small pieces of clean gauze around small masses of wadding. If required to be used dry they can be sterilised by being placed in a glass stoppered jar and kept in an oven at a temperature of 160° C. for about an hour. Sponges, to be rendered sterile, have to pass through a complicated process of washing and soaking in solutions of hydrochloric acid, boiled water, soda, sulphurous acid, boiled water again, and lastly some antiseptic lotion.[1]

Preparation of the Operator's Hands.—This part has been placed second to that of the treatment of the instruments, because in these days of aseptic and antiseptic surgery it seems hardly necessary to say that the operator should pay particular attention to the condition of his hands, nails, etc.

If an excuse is necessary for alluding to the subject it must be that the student does not easily understand the importance of always going through a regular routine before operating. Again, in veterinary operations it is not at all times possible to get the assistance and spotless surroundings which accompany the surgeon in human practice.

The operator in veterinary practice has to attend personally to the securing of the animal, and in doing so is compelled to touch parts of the latter's body which are far from clean according to bacteriological ideas. Before operating, the hands, and particularly the nails, should be thoroughly scrubbed with soap and hot water (containing some antiseptic) by the aid of a nail brush, and then held for a few minutes in some clean antiseptic solution. In abdominal, and some of the more serious operations, it is a wise precaution in addition to scrub the fingers with a little ether on cotton wool in order to remove all grease. During the operation care must be taken not to touch anything which has not been rendered aseptic, and if by accident this is done the hands must be again carefully disinfected before touching either the wound or the instruments. The wound should be touched with the fingers as little as possible. The choice of the antiseptic must be left to the operator, care always being taken to make it of sufficient strength. Any of those mentioned in the previous paragraphs are suitable, the only precautions necessary being taken in the cases of carbolic acid, lysol, and creolin, which have an irritant effect on the hands of some, especially when the solution is very concentrated.

[1] "Aseptic Surgery," C. B. Lockwood, p. 184.

(To be continued.)

THE MILROY LECTURES[1] ON THE EARTH IN RELATION TO THE PRESERVATION AND DESTRUCTION OF CONTAGIA.

DELIVERED AT THE ROYAL COLLEGE OF PHYSICIANS OF LONDON.

By G. V. POORE, M.D., F.R.C.P., Lond.,
Professor of Medical Jurisprudence and Clinical Medicine, University College; Physician to University College Hospital.

Earth.

THAT which we commonly speak of as "earth" is largely composed of excreta and the dead remains of animals and vegetables which, as the result of fresh biological processes, are either returned to the bodies of living vegetable organisms, or, after becoming mineralised and soluble, are washed downwards by the rain and ultimately find an exit in the sea. It is obvious that not only does "earth" vary in composition with the varying conditions of subsoil, climate, flora and fauna, but that "earth" must undergo seasonal variations necessitated by the vigorous upgrowth in the spring or the decay of the fall—the heat and drought of summer or the flood and frost of winter. The interstices between the particles of "earth" are filled at one time with air, at another time with water, and the line of demarcation between earth and air on the one hand, and earth and water on the other, is often not very definite. Again, the dust which is suspended in the air and which settles on everything is liable to contain infective particles, harmless to breathe but dangerous if they fall upon a wound. It is obvious that such particles may be regarded as belonging to the earth or the air. Some of them doubtless emanate from the earth, having been raised as dust; but we must admit that there may be organisms which grow in the air, live in the air, and die in the air, without ever touching earth or water, and which elude all attempts at identification or artificial cultivation. While there are organisms which may live equally well in air or water, others are probably more exclusive in their obligatory conditions. The mutual interaction of earth, air, and water must never be lost sight of. It is the life in the earth, both vegetable and animal, which helps, by its influence on vegetation, to maintain the quality of the atmosphere. Again, it is the earth which gives the quality to spring and river water. Pure water is a body of definite chemical composition, and pure air is a tolerably definite mixture of gases, and it is not difficult to approximately measure the degree of pollution of either. The chemical composition of earth, however, is complex and constantly changing, so that it is not possible for the chemist to fix any standard of quality. The practical agriculturist by the aid of touch, smell, and vision will say at once whether any given sample of earth is foul or pure, sour or sweet, rich or poor, fertile or sterile, and we must perforce content ourselves with the terms used by the practical man. The word "earth" in the ensuing lectures will usually be regarded as meaning humus in a healthy condition.

[1] Reprinted from the "Brit. Med. Journal," 25th Feb. 1899.

There are certain organisms which are constantly found in the earth, and which appear to be ubiquitous. They adhere to our skins and clothing, get under the nails, and lodge in the hair. They produce various disorders of wounds and diseases in wounded persons, and we now recognise that in the absence of those precautions which we call "antiseptic" it is never safe to inflict even the smallest wound. The organisms which produce the various wound infections are saprophytes which flourish external to the body. They are ubiquitous and (probably) necessary, and so long as we have a whole skin and uninjured mucous membrane they do us no harm. As all organic matter is constantly circulating, passing through death to other forms of life, and necessarily undergoing humification in the process, it follows that the agents of these changes, the microbes which are to this end hatched in the soil, vary with the circumstances. Dr Houston [1] gives the estimated number of microbes per gram found in twenty-one samples of soil. These vary from 8326 in a virgin sand and 475,282 in a virgin peat, to 115,044,492 in the soil from the trench of a sewage farm. Broadly speaking, the microbes bear a direct proportion to the amount of dung. Warington estimated that a gram of dung from a cow fed on hay contained 165,000,000. They all presumably have their optimum conditions—chemical and physical qualities of the nutritive medium, access of air or other gases, lightness or darkness and temperature—and when the optimum conditions concur, growth and multiplication go forward at a pace which we can hardly appreciate. The fact that for the growth of some the access of air is necessary, while others obtain their oxygen from the medium in which they grow, and others again are able to take in oxygen from either source, has formed the basis of a classification which has assisted our understanding.

Saprophytes, including those which produce wound infection, are presumably of service in bringing about the decomposition of complex organic bodies. Whether we are able to check the growth and multiplication of these facultative parasites outside the body is doubtful, and whether or not we should be gainers by so doing, is still more doubtful. Bacteriologists have experienced no little difficulty in discovering the exact conditions which are necessary for the growth and development of many of the micro-organisms which have been studied. Some organisms are more exacting than others, and those which are best able to accommodate themselves to varying circumstances naturally obtain the mastery when several are attempting to grow simultaneously in the same medium. Some of the larger saprophytes, such, for instance, as the common mushroom, require no little skill for their artificial production, involving far more attention to exact details than is necessary with ordinary green-leaved garden plants. We know that for a few weeks in the autumn they may appear in great numbers in dry pastures where horses have been fed, provided the conditions of the air as to temperature, light, and moisture be favourable, and we also know that directly the necessary conditions fail, the mushroom harvest is at an end. We also know how strange is the predilection of certain fungi for the dung of particular animals, and I would allude to a list furnished to me by Mr George Murray, F.R.S., which shows that the optimum conditions for the growth and development of these

[1] Local Government Board Report, 1897-98.

short-lived and delicate organisms must be marvellously subtle, probably quite beyond the ken of the chemist.

I will now proceed to deal *seriatim* with some of the contagia which are best understood, and will begin with

Tetanus.

Among the organisms which are habitually found in earth is the bacillus of tetanus. It is said to be present in almost all rich garden soils, and that the presence of horse-dung favours its occurrence. It is strictly anærobic, and has been artificially cultivated by Kitasato in an atmosphere of hydrogen. It forms spores, and grows best at a blood heat. Marchesi has found it at a depth of 2 metres, but no lower. The pure cultivation of the bacillus, which has a disagreeable aromatic odour, is often not very virulent. It is fatal to animals as well as man, and among animals the horse appears to be most liable to be attacked. Infection always takes place by inoculation through the wounded skin or mucous membrane—never, it is believed, through the healthy alimentary or respiratory tracts. Cases of "idiopathic" tetanus are reported, but it has fallen to the lot of few of us to see a case, and professional opinion seems to lean to the idea that in such cases the inoculated wound has been overlooked. The toxin which the bacillus brews locally in the wound is toxic to the central nervous system, and the antitoxin to be effectual must, it is said, be injected subdurally into the central nervous system. The exhaustion of the nervous system seems to increase its vulnerability, which is, perhaps, the reason why tetanus has been relatively common in the domain of military surgery. There seems to be no doubt as to the ubiquity of the tetanus spore. Every child who falls on the ground and gets an abrasion of the skin, all tillers of the soil who get accidental wounds in the course of duty, and every horse which "breaks its knees" by falling in the London streets, runs a risk of inoculation with tetanus. I have made inquiry of many practitioners in the Thames valley where market gardening is the chief industry, and where countless tons of London horse-dung are spread upon the land, and learn from them that tetanus is, in their experience, the rarest of diseases. Seeing that the bacillus is so strictly anærobic, one is justified in supposing that the tillage of the soil, which brings it in contact with the air and sunshine, must be unfavourable to its growth and virulence. The bacilli must die out under such conditions, and the inoculation of the spores alone is said by Vailliard, Rouget, and Vincent to be incapable of setting up tetanus. If the bacillus or the spore be carried in dust, or if either be washed into the water and drunk, we have no evidence that any harm results therefrom. In common with other microbial diseases, tetanus is more virulent in the tropics than in temperate climates. Friedberger and Fröhner state that it is so common among horses in St. Domingo, especially after the operation of castration, that geldings are worth twice as much as stallions.

In an article by Mr Sidney Villar in the *Journal of Comparative Pathology and Therapeutics* for December 1897, an observation by Mr Joseph Woodger is quoted, to the effect that tetanus is particularly common among horses used in dust-carts, and Mr Villar continues: "In my own practice in Middlesex there are two farms where the disease is specially prevalent. One of these, at Alfreton, is occupied

by a farmer who habitually spreads on his fields large quantities of London refuse; at the second farm, 5 miles away, the bailiff brought two large loads of the sweepings of London roads in 1893 and dressed his home meadows with it. On these meadows his colts and young stock were pastured, and for two and a half years tetanus was endemic on his farm; during this period six colts became affected, and I believe only one entirely escaped the disease."

This experience of Mr Villar seems to point to the danger of placing upon grazing land material which is probably mixed with broken glass or crockery.

In connection with Marchesi's observation that the tetanus organism has not been found at a greater depth than 2 metres, I would allude to a fact, to which I shall return later, that this approaches the maximum depth to which the earth-worm burrows. It is obvious that if a spore were carried downwards by a worm it would meet with anærobic conditions favourable for its preservation. It is remarkable that in face of the ubiquity of the cause, the disease in man should be so rare. This is probably in part due to the fact that we wear boots.

Anthrax.

Anthrax is a disease which is undoubtedly connected with the soil. The bacillus was discovered by Pollender in 1849, a discovery which is just fifty years old, and marks the dawn of pathological bacteriology. The identification of the bacillus in the laboratory and the diagnosis of the disease in animals from quarter evil and septicæmia is not without difficulty, and are sufficient to throw a shade of doubt over some of the earlier observations, but the discovery of bacilli anthracis in the blood clinches the diagnosis. It was in 1850 that Rayer and Davaine described the bacilli, and in 1877 Pasteur communicated to the Academy of Sciences the important fact of sporulation observed in these bacilli by Koch and himself, and, further, pointed out that the bacillus anthracis was essentially ærobic, and was quickly destroyed in the blood of the dead animal after the onset of putrefaction.

In August 1878, M. Pasteur fed sheep on lucerne previously watered with a pure cultivation of bacillus anthracis, and found that "in spite of the immense number of spores taken in with the food many of the sheep escaped death." The mortality was much increased when the infected food was mixed with prickly material such as the leaves of thistles and the chopped heads of barley, and the *post-mortem* examination of sheep rendered *charbonneuses* by fodder of this kind gave reason to suspect that they were really "inoculated" through injury by the prickly food at the back of the throat.

It is recognised by professional "knackers" that they run little risk of contracting "charbon" by manipulating dead animals far advanced in putrefaction, and both Pasteur and Koch have shown that putrefaction soon destroys the bacilli in the blood and tissues of an animal, and that being ærobic sporulation does not take place inside the putrefying body, but is very liable to occur in the blood which escapes from it whether upon the earth or a dung heap.

In August 1878, Pasteur made a necropsy on the body of a sheep and then buried the carcase. Ten months and fourteen months afterwards Pasteur found spores of anthrax in the earth of this animal's grave, and established the fact by the inoculation of guinea-pigs. The

spores were found in the surface soil over the grave, although since the burial the ground had not been moved. Similarly spores were found in the soil over the grave of a cow buried two years previously, and at a depth of 2 metres. These spores were found over the graves of dead animals after all the operations of cultivation and harvest. Earth taken at a distance from these graves did not give charbon.

He attributes the uprising of spores to the action of earth worms, and claims to have actually recovered spores from the bodies of earth worms living in soil polluted with anthrax. In a footnote Pasteur calls attention to the fact that in Cantal there are pastures which from time immemorial have escaped (*sont épargnés*) and others in which from time to time the cattle were decimated, which are known as *montagnes dangereuses*, and are abandoned for several years at least. "But the cause, whatever it may be, which produces charbon in a locality disappears with time." In Beauce Pasteur saw certain fields in which the folding of sheep had been interdicted for several years —that is, since the last death thereupon from charbon. "Now we placed flocks of sheep on five of these fields, and the mortality was *nil*, except in one flock where it amounted to 1 per cent."

M. Colin of Alfort, a professor at the Veterinary School, controverted some of Pasteur's experiments; a further report therefore was made on 17th May 1881, by a commission composed of M. Bouley, M. Davaine, M. Alphonse Guérin, and M. Villemin. Earth from a twelve-year grave, a three-year grave, and from virgin soil was kept at a temperature of 90° C. for fifteen minutes, and the fine sediment injected into guinea-pigs. Of five guinea-pigs inoculated with twelve-year earth on 19th March, four died on 21st and 22nd March from septicæmia, and one died on 23rd March from charbon. Of five guinea-pigs inoculated with three-year earth on 19th March, four died from 21st to 23rd March from septicæmia, and one died on 23rd March from charbon. Of five guinea-pigs inoculated with virgin soil on 13th March none died. One had a small abscess at the seat of puncture. Of six guinea-pigs inoculated with twelve-year and three-year earth on 30th March, five died from septicæmia on 3rd April, and one died from charbon (twelve-year earth) on 3rd April. Of three guinea-pigs inoculated with excreta taken from the bodies of living earth worms, two died from septicæmia and one from charbon on 30th March. Of the nineteen animals killed by the above experiments, fifteen died from septicæmia and four from charbon.

Since 1879 M. Pasteur had asserted that most soils when inoculated were capable of causing death from septicæmia quite apart from any contamination by the death of anthrax animals. Of three guinea-pigs inoculated on 28th March with worm castings taken from above the graves of some of the victims of the Commune, situated on waste land, one died from septicæmia on 1st April and two were unharmed.

Pasteur had clearly demonstrated that the anthrax bacillus is essentially ærobic, that it is soon destroyed by putrefaction, and that for sporulation free exposure to air and a temperature above 15° are necessary. These facts seem out of harmony with the view that earthworms bring spores from a deeply buried carcase to the surface, while the skinning and transportation of an animal dead from anthrax must necessarily be a most dangerous process.

All are agreed that anthrax is a disease liable to haunt localities. It is alleged by Friedberger and Frohner that the spores may vegetate in the soil and surface water quite independently of the animal body. The disease is said to occur among horses, cattle, and buffaloes in Eastern Bengal, Manipur, and Burmah without the agency of infection, and to be in that part of the world a truly miasmatic disease. As spore formation requires something like a blood heat, it is only what might be expected to find the disease becoming endemic among cattle and horses in tropical countries. Where infected animals drop dung and other discharges on the soil, it becomes impossible to say whether the infective spore originates in the soil or in the animal. These authors assert that "there exists a well-marked connection between the disease and the amount of moisture in the soil. It appears most frequently in low lands and plains exposed to inundations and great heat." Copeman also asserts that the disease is prevalent on damp soils containing much humus, as, for instance, upon peat bogs, and near the borders of lakes and rivers which have overflowed. On the other hand, we have Pasteur speaking of "*montagnes maudites*" in connection with anthrax, and asserting that the mortality is great in soils which are *secs et calcaires*.

Many of the outbreaks of anthrax in this country have been in the neighbourhood of Bradford, and have been traced to the use of infected wool refuse as manure. A map, published by the Board of Agriculture, shows that the outbreaks of anthrax are most frequent in those counties of Great Britain where *dry* foreign wools, hairs, hides, and skins are manufactured into goods. It is the anthrax spore which is the danger, and if, as is the case, a high temperature and free admission of air be necessary for sporulation, an excess of water would be unfavourable for that process. There seems a concurrence of opinion that the bacillus anthracis is killed by putrefaction, and soon disappears in the unopened and unskinned body. The advice which is usually given in this country to bury anthrax carcases deeply and unopened and unskinned is doubtless sound, although it is doubtful if the depth of the grave adds materially to the anærobism of the surroundings. It is very doubtful if in an unopened body spore formation be possible after a short period of burial. It is clear that the animal should be buried at the spot where it dies, and that the spot should be planted with a few saplings of some indigenous tree. The value of "quicklime" is doubtful.

All Pasteur's experiments in relation to graves appear to me to be vitiated by the fact that they took place in an anthrax district, and it is very difficult to say whether the spores were derived from the buried animals or from the dung of infected ones which had been used as manure, or from the blood-stained wool which, we are told, is of "bad omen" in a flock. It is a noteworthy fact that of the nineteen guinea-pigs inoculated by the Alfort Commission four only died from anthrax, and fifteen from septicæmia; and that the earth from the three-year-old grave and from the twelve-year-old grave conveyed anthrax in the same proportion, that is, one in four inoculations. There seems no doubt that spores may be found in earthworms or their castings, and there is equally no doubt that if the worms have brought the spores from the depths of the earth, such spores must

have originally been formed on the surface. It is, of course, quite impossible to say whether a worm swallowed the spore on the surface or below it, and it is certain that recently dead bodies have no attractions for worms.

There are some discrepancies amongst observers as to the infectivity of food grown on anthrax ground. On the one hand, Pasteur was unable to do much harm to sheep by feeding them on lucerne sprinkled with spores, and, on the other hand, we have a story quoted by Pasteur of an old woman whose goat and cow died from anthrax when fed with clover stolen from over a grave two years after the burial of an anthrax animal.

Anthrax in the human subject is a rare disease. Man is never infected through the alimentary tract, as appears to be the rule among animals. Cutaneous anthrax (malignant pustule) is caused by direct inoculation.

Pulmonary anthrax, or wool-sorter's disease, was first noticed in the Bradford worsted district after the introduction of alpaca and mohair as textile materials in 1837. It appears to be generally accepted that "this form of anthrax may attack any person exposed to the inhalation of anthrax spores in dust arising from the products of diseased animals." And yet I have hitherto found no records of pulmonary anthrax from the inhalation of dust from highly manured ground which must, one would suppose, especially in the West Riding of Yorkshire, often contain anthrax spores. The lungs of the agricultural labourer and the market gardener appear to be immune to the infectivity of anthrax spores. It seems to be of very great importance to bear in mind—(1) that anthrax spores persist even in the finely pulverised soil of worm castings, which must be very easily dried and converted into dust; (2) that anthrax may undoubtedly infect man by the inhalation of dust; and (3) that pulmonary anthrax among agriculturists has not been recorded. The persistence of the anthrax spore in the earth does not admit of a doubt, but there is no evidence that man is ever infected directly from the earth. How far anthrax in animals is due to inoculation rather than to feeding requires further and very careful investigation.

Diarrhœa.

Diarrhœa is a disease which in its epidemic form has been supposed to be engendered in the earth.

The third quarter of the year 1898[1] was characterised by a very large infantile mortality, mainly attributable to diarrhœa. The rainfall for the quarter was unprecedentedly small, the temperature was above the average, and the harvest was one of the best on record.

Excluding the towns, infant mortality in the remainder of England and Wales was in the proportion of 184 to 1000 births. Diarrhœa caused 22,524 deaths, equal to an annual rate of 2·85 per thousand, or 1·21 above the average rate of mortality in the third quarters of the previous ten years.

The mortality from diarrhœa was, however, mainly urban; the rates averaged 3·85 per 1000 in the thirty-three great towns. Among counties it is the rural which have least and the industrial which have most diarrhœa; and if we turn to the mortality returns for those

[1] Quarterly Return of the Registrar-General.

counties where diarrhœa was especially rife, we shall find the mortality greatest in the urban districts. It is a point not without interest to note that the diarrhœa death-rate and the fever death-rate in this quarter bore no relation to each other, and that, while the diarrhœal death-rate was 1·21 above, the fever death-rate was 0·03 below the average for the corresponding quarter of the last ten years. In the following table some figures are collected which show this very strikingly.

Table showing the Death-rates per 1000 from Fever and Diarrhœa during the Third Quarter of 1898.

	Fever.	*Diarrhœa.*
England and Wales	0·16	2·85
London	0·11	3·19
Wolverhampton	0·18	6·38
Leicester	0·13	5·34
Manchester	0·09	5·38
Preston	0·28	6·41

Diarrhœa is a disease of hot weather. Ballard thought that when the four feet temperature of the earth reaches 56° F. diarrhœa becomes common. Tomkins of Leicester (Leicester is a "diarrhœa town") shows that the disease becomes common when the one-foot thermometer stands at 60°. Snow of Buffalo, U.S.A., showed that in 1886-88 diarrhœa mortality was highest when the minimum atmospheric temperature attained its highest average range. The London statistics for 1887 and 1888, collected by Dawson Williams, show a similar relationship between diarrhœa and a high average minimum range of temperature. Copeman considers it highly probable that the disease is due to "microphytic processes" going on in the upper layers of the soil. "This would afford an explanation of the fact that summer diarrhœa is especially a disease of cities having a polluted soil."

The bacillus enteritidis sporogenes is believed by Klein to be the cause of infantile diarrhœa.[1] It is an anærobic bacillus which forms spores, and may be easily cultivated in milk. It is fatal to rodents when injected hypodermically, and produces a foul-smelling, bloody œdema of the cellular tissue and adjacent muscle tissue. The spores were found in four out of ten cases of infantile diarrhœa examined, and in six out ef eight cases of "cholera nostras." It was found in eight out of ten samples of milk purchased in London milk shops between April and the end of June (when diarrhœa was not epidemic ?) including samples of so-called "pure sterilised milk." It has been found in large quantities in sewage and in sewage effluents. It is

[1] Twenty-seventh Local Government Report, 1897-98.

found in horse dung, and in all matters polluted with it. It has not been found in pig dung or cow dung, or in the dung of a healthy human being.

In face of the wide distribution of the microbe, it is evident that the vulnerability of the individual must be an important factor in determining an attack of diarrhœa. If we are to consider diarrhœa as a soil disease, it is evident that its cause exists only in the upper layers. It is more common among city streets than in agricultural districts. According to Klein, the probable cause is largely to be found in horse dung which is pulverised and blown about generally. That it is a "soil" disease in any true sense is certainly not proven.

[The lecturer at this point discussed dysentery, cholera, and Malta fever as soil disease, and then proceeded as follows:]

Plague.

Plague has been regarded as a soil disease, but recent evidence must materially modify this opinion. Experiments carried out in districts where a disease is epidemic or endemic necessarily acquire a measure of certainty from that fact alone. The unfortunate accident which occurred last year in Vienna, much as one may deplore it, was an object-lesson of the greatest value, and converted what many regarded as mere theories into facts which all can read and understand. In the recent epidemics in the East the theory that plague grows "in the soil" has received no support whatever.

In India the two facts which have come to the front are the danger in relation to plague of (*a*) rats, and (*b*) abrasions on the skin; and it may be said that the following are the most important items in the spread of plague:—

1. Filthy habits of the people, such as spitting over the floor and others mentioned above.
2. Filthy houses.
3. Overcrowding, and consequent rapid increase of contagious disease when once imported.
4. Presence of rats, insects, and other vermin.
5. The naked condition of the people going about, such people presenting almost unlimited opportunities for the entrance into their tissues of plague poison by inoculation and through abrasions.
6. Pollution of soil and houses with the excretions of man and animals.
7. Filthy clothing and absence of bodily hygiene.

Diphtheria.

Dr Arthur Newsholme, in his work on *Epidemic Diphtheria* (1898), while admitting that personal infection is the chief means by which diphtheria is spread, contends that "the specific micro-organism of this disease has a double cycle of existence, as have the specific micro-organisms of enteric fever, erysipelas, scarlet fever, rheumatic fever, etc. One phase is passed in the soil, another in the human organism. One is saprophytic, the other parasitic.[1] It is not strange, therefore, that the epidemic prevalence of all the above diseases is

[1] It is not contended that there is a regular alternation of saprophytic and parasitic generations, but that such alternations do occur.

favoured by deficient rainfall if this is sufficiently long continued. This deficient rainfall implies a low subsoil water and a subsoil above the level of this water which is relatively dry and warm, probably the optimum conditions of the saprophytic life of the above pathogenic micro-organisms. The causes of the transition of the diphtheria bacillus from the saprophytic to the parasitic phase of life may be surmised both as regards (*a*) season, and (*b*) years of special epidemic prevalence. Diphtheria is most prevalent in the autumn and early winter months, when the optimum temperature and the optimum degree of humidity of the soil are rapidly disappearing or have departed. It is also most prevalent after the wet weather occurring in or immediately following exceptionally dry years. Both these conditions tend to raise the ground water and to drive out any pathogenic micro-organisms from the soil."

Dr Newsholme is of opinion that, in order to account for the epidemic and even pandemic waves of diphtheria, "the diphtheria bacillus under certain conditions becomes more actively virulent and infective, more remote from its saprophytic phase of life, and that thus persons who can resist the ingress of the feebler fall victims to the more powerful micro-organism." The latter is probably the correct hypothesis, and the evidence already given clearly points to the conclusion that of the external cultural conditions leading to increased virulence of the diphtheria bacillus, and greater readiness for assuming a parasitic life, exceptional deficiency of rainfall, and consequent exceptional deficienty of moisture in and exceptional warmth of the subsoil, form an essential part.

The above is a very ingenious hypothesis, but it is essential to point out that the diphtheria bacillus has not been recovered from the soil, and that the bacilli of rheumatic fever and scarlet fever have not yet been identified. Before Dr Newsholme's hypothesis can be accepted a great deal more evidence will be necessary.

Dr Newsholme's figures generally seem to show that diphtheria is now a disease more of the towns than of the rural districts. It is not very easy to understand how, in a city where pavements and other impermeable coverings to the soil are general, the bacillus is driven by the rising subsoil water into the air. Of course, it may be driven out of the sewers and sewer ventilators, in which case it becomes a sewer disease rather than a soil disease. Most of the facts collected by Dr Newsholme are explained as readily, if not more readily, on the theory that diphtheria is an air disease as upon the theory that it is a soil disease. That diphtheria is a soil disease is certainly not proven.

Malaria.

A few years ago I should have spoken of "malaria" as undoubtedly caused by something in the soil itself, but the discovery of hæmatozoa in the blood of sufferers from malaria has altered our point of view. The most widely spread poison in the world has become something which is visible and tangible and inoculable. No discovery which has ever been made in the domain of medicine is likely to have such far-reaching effects: Further, it seems certain that the infection of human beings may take place *viâ* the mosquito, and we are now concerned to find out whether this is or is not the only medium through

which the blood of man receives the parasite. Some who are well qualified to speak would answer in one way and some in another.

If, however, on the one hand, we are able to show Europeans the importance of protecting themselves against the attacks of insects, we must, on the other, continue to make use of our accumulated knowledge as to the conditions of soil which indirectly cause remittent fevers to be epidemic. The conditions of soil which give rise to malaria are too well known to need any lengthy discussion here, but air-borne infection or water-borne infection cannot be lightly dismissed.

It is generally conceded that the turning up of virgin soil is one of the most fruitful causes of malignant malarial fevers, and under this heading is included blackwater fever, which has recently become so common. Surgeon Bowden, R.N., D.S.O., informs me that the turning up of fresh soil is often followed by an influx of mosquitos. On the other hand, the cultivation of the soil seems ultimately to lead to the decrease and disappearance of malaria.

After referring to a group which (like malaria) seems to be dependent upon the bites or stings of insects which, affecting animals rather than man, yet throw much light upon the pathology of infection; a group including ngana or tsetse fly disease; the "louping ill," a disease which is common in the North of England and Scotland which has been noticed to be fatal to sheep frequenting certain pastures; Texas fever of cattle; and the South African horse disease, the lecturer concluded as follows: There are other diseases more or less suspected of being soil diseases, but the facts are at present too few to make any discussion of them profitable. These are yellow fever, beri-beri, swine fever (undoubtedly propagated by fouling of the surface soil), cancer (?), thread worms, hydatids, and ankylostoma duodenale.

THE STUTTGART DOG EPIZOOTIC.[1]

(CONTAGIOUS GASTRO-ENTERITIS AND ULCERATIVE STOMATITIS IN THE DOG.)

By Professor KLETT, Stuttgart.

ON the 13th of August last year an old dog was brought to the Clinique of the Veterinary College exhibiting symptoms which excited our interest on account of their uncommon character. This interest was considerably enhanced when, apparently not by mere accident, a succession of strikingly similar cases were brought for treatment. This sudden occurrence of a number of similar cases suggested the existence of some epizootic disease among the dogs, and, as a matter of fact, the so-called "Stuttgart dog disease" was soon in everyone's mouth. Whereas the members of the profession, in consideration of many points, refrained from expressing an opinion regarding the nature of the disease, the lay authorities on dog diseases did not hesitate to offer explanations on the matter, both in the daily press and in conversation. Some declared that the disease was distemper, others suspected poisoning, and at the

1 Translated from the "Deutsche Thierärztliche Wochenschrift," February 1899.

outset this led to an almost general belief among the public that the dogs were the victims of malicious deliberate poisoning by some ill-disposed persons. Still others, on account of the great resemblance in external symptoms, regarded the disease as a sort of foot-and-mouth disease. The most confusing accounts of the course of the disease and infallible therapeutic measures were also forthcoming. In a remarkable article (doubtless inspired by a professional man) which appeared in a sporting paper, it was stated with precision that the disease was a hitherto quite unknown affection, characterised by a hæmorrhagic gastro-intestinal catarrh, and generally combined with inflammation of the mucous membrane of the mouth.

In the following pages I shall endeavour to state my views regarding the nature of the disease, based on the observation of a large number of cases of varying severity and course, as well as on what has already appeared on the subject in print.

In order to convey to the reader a picture of the commencement and course of the disease, and also to furnish material on which he may form an independent opinion regarding it, I shall first describe a number of cases selected so as to illustrate all the different points in connection with the affection.

CASE I.—(Peracute course; ulcers.)

A very well bred fox terrier belonging to one of our students became ill about mid-day on the 23rd of November last, being seized with sudden vomiting. In the morning the dog had been in the best of health, was lively, and would jump, and fetch and carry. The vomition set in immediately after the dog had taken some water. At the same time a profuse bloody diarrhœa set in, the appetite was entirely lost, and the general appearance very dull. The animal stood crouched up, with arched back, and could not be induced to leave its cage. Whereas formerly the dog would not allow strangers to touch it, it could now be handled by anyone. It also had severe rigors, and was very thirsty. The rectal temperature was 37·5° C. It is uncertain whether the dog had previously had distemper or not, but it had been bought on the assurance that it had.

Immediately after the animal was observed to be ill it was brought to the Clinique, where its condition was noted as follows:—

Strong, well-built fox terrier, well nourished, and well kept, but extremely weak. It is too miserable to stand or walk. When supported on the table the vertebral column is kept in the curved position, and the abdominal wall is much tucked up. While being manipulated it remains quite passive, but when pressure is exerted on the region of the stomach it groans and makes feeble movements indicative of pain. From time to time its whole body is shaken by a rigor. The skin and lymphatic system show no abnormalities. The expression is dull and listless. The eyes are retracted in the orbits, the conjunctiva moderately reddened, its vessels and their branches being distinctly visible. No discharge from the nose. Respiratory apparatus normal. The respirations are deep and quiet, about 23 per minute. The skin temperature is everywhere regular; internal temperature 37·6° C. The pulse is weak, but uniform and regular, about 100 beats per minute. The heart beats are tumultuous, easily felt, and rythmical; the heart sounds are normal.

From the mouth, which is kept open in a cramp-like manner, and

the neighbourhood of which is not at all dirty, an extremely offensive odour is exhaled. The tongue lies motionless and limp in the mouth; it is wrinkled and thickly furred. The mucous membrane is dark red and dry. On the mucous membrane of the upper lip there are several round red erosions, about the size of pin's heads. Similar erosions, but somewhat larger, and covered with a thick, dirty yellowish layer, are found immediately behind the molar teeth as far as the region of the tonsils. The mucous membrane of the throat is only moderately reddened. While the animal was being examined it passed with symptoms of pain a quantity of quite watery, very stinking, brownish-red fæces, resembling almost pure blood. On microscopic examination this showed masses of red blood corpuscles, besides a sparing number of leucocytes and a considerable quantity of epithelium. No urine was obtainable with the catheter.

Until the evening there was no change for the worse in the condition of the animal. The appetite was quite suppressed, but the dog appeared to be very thirsty, though it was unable to swallow. The temperature stood at 37° C., pulse very small, about 120 per minute. Breathing quiet, about 20 in the minute.

On the morning of the 24th November the temperature was 35·9° C. The animal lay in deep coma, the mouth open and the tongue hanging out motionless. The point of the tongue was blackish-brown and insensitive to the prick of a pin. Towards the middle of the day, when the temperature had fallen to 34·7° C., the coma ended in death.

CASE II.—(Severe ulcerative changes and necrosis.)

A two-year-old Dachshund dog belonging to Dr L. was seized with sudden vomiting without recognisable cause on the 24th of October. At the same time the appetite was entirely lost, an almost unquenchable thirst set in, and the animal became very dull and weak. The owner immediately consulted a veterinary surgeon, but as the disease steadily became worse he brought it to the Dog Clinique at the Veterinary College here on the morning of the 27th October. Its condition then was as follows:—

Patient well built; general condition bad. Hair lies smoothly, and is sleek and shining. The skin shows no abnormality, but the extremities feel cold. The palpebral conjunctiva is deep red, the eyes sunken, and the vessels of the scleral conjunctiva are markedly injected. The sclerotic has a tinge of yellow, but the eye itself appears normal, and there is no discharge from it. The temperature is 35·5° C. The pulse is small, very frequent (138 per minute), but otherwise normal. The arteries are soft and relaxed. The pulsations of the heart can be both felt and seen over a wide area on each side. The cardiac sounds are audible and normal. The respiratory movements are carried out quietly, and number 32 in the minute. The respiratory apparatus is normal.

The first thing to strike one on examining the digestive apparatus is a disgusting odour from the mouth. There is no flow of saliva. The buccal mucous membrane is cool and moderately moist, and its colour is a diffuse brownish-red. Over the whole of the upper lip the mucous membrane carries numerous streak-like and punctiform excavations, sometimes simple, sometimes in the form of erosions with a raised margin, bright red, and apparently painful to the touch. Oppo-

site the upper corner incisors, the canines, and the molars, the mucous membrane shows extensive changes in the shape of ulcers with ragged edges, varying in size and shape, and covered with a dirty brownish-yellow dry crust. Very deep ulceration is also recognisable in front of and over the tonsils. In the same place there are also some deep round pits, the entrance to which is regularly toothed, and about the size of a penny-piece, while their bases and lateral walls can be seen only when a good light falls on them. The latter are intensely reddened, and appear as if pieces of tissue had been torn out with forceps, so as to produce a ragged surface. At some places the surface is covered with a spongy material. A notable feature is the considerable swelling of the gums around the canine teeth. Like the mucous membrane of the mouth, that of the throat has a brownish-red colour. The tongue, which is chocolate-coloured and thickly furred, shows near the middle of its tip various erosions partially covered with a necrotic scurf, while its edges at some places carry similar erosions and black necrotic spots. The abdomen is moderately distended. Palpation of it, especially over the region of the stomach, provokes evidence of acute pain. On auscultation nothing is heard beyond occasional tinkling and rumbling sounds. Now and again the animal utters a low groan and strains, especially at the time when the rumbling sounds are heard. The appetite for both solids and liquids is entirely suppressed. No fæces are passed, and the medicine administered is immediately vomited. The vomited matters contain clear mucus mixed with small coagula of blood. After each effort a loud and painful rumbling sound is audible in the abdomen.

The animal is in a soporous condition. Only the quiet breathing and an occasional slight rigor passing over the body show that it is alive. It cannot be made to walk, and after standing on its legs for a little it sinks down. The reflexes are present, but the cutaneous reflex (on pricking with a pin) is slight. There are no convulsions. The urine contains albumen. The result of ophthalmoscopic examination is negative.

At 6 P.M. the condition was the same. Temperature 35·2° C.; pulse 130, scarcely perceptible; respiratory movements 30. The animal immediately vomited all the medicine administered in the course of the day. It groaned frequently and was restless.

28th October, 8 A.M.—Temperature 34·8° C.; pulse very irregular and thready, and perceptible only about forty times in the minute; respirations 16. Great depression, but the region of the stomach is still extremely sensitive to pressure. The animal frequently groans spontaneously. Important changes have taken place in the mouth. The smell from it is abominable—carrion-like. Almost the entire mucous membrane of the mouth is covered with a yellowish-red, dirty, stinking layer, and pure blood adheres to some of the teeth. The tongue shows up prominently from the buccal mucous membrane. It is of a dirty, greyish-green colour, and as flaccid as if it were dead. External to the mouth there is nothing abnormal to be observed.

The animal died without convulsions about 10.30.

CASE III.—(Youngish animal; slight ulceration; difference from distemper.)

On the forenoon of the 3rd September Mrs P. brought her dog—a five-months-old Griffon—to the College Clinique, with the history

that three days previously it had been seized with sudden illness without recognisable cause. Since then it had eaten absolutely nothing, had vomited whenever food was offered to it, had passed neither fæces nor urine, and had become much emaciated. She feared that the animal had been poisoned by some malicious neighbour. It had been in her possession for a couple of weeks, and she did not recollect that it had been ill previously. She was not acquainted with the symptoms of distemper. The condition of the dog was now as follows:—

It is much emaciated; its coat stares and is dull in appearance. The movements of the animal are very dull and listless. In moving, however, it shows no disturbance of equilibrium. General sense blunted. The conjunctiva is bright red, and its vessels are quite moderately injected. General integument normal. No abnormalities are to be seen or felt in connection with the lymphatic apparatus. The nose is dry, fissured, and cold. There is no cough, and no abnormality is detectable on percussion and auscultation. The temperature is regularly distributed over the surface of the body. The internal temperature is 38·7° C.; pulse 38 per minute, normal in rythm and quality. The heart-beats can be felt distinctly; heart-sounds normal. The breathing is regular, 28 per minute. No urine is obtainable with the catheter. The neighbourhood of the mouth is not dirty. The mucous membrane of the mouth is reddish-brown in colour. Opposite the canine teeth the mucous membrane shows a deep erosion, sharply marked off by a deep red swollen edge. The ulcer is covered with a somewhat firmly adherent layer, which, when removed, shows the base to be ragged and of a deep dark red colour. The ulcers bleed easily and feel somewhat firm. Similar ulcers are present on the upper lip, and on the mucous membrane of the cheeks in the neighbourhood of the upper incisor and molar teeth, these being about the size of a pea. On the mucous membrane opposite the lower incisor teeth there is a half impression of these teeth, and here the deposit is somewhat thicker. Immediately behind the ridges of the hard palate, and near the middle line of the mouth, there is an ulcer similar in outline to a butterfly with the wings spread out. This is about 2 cm. long and about 1¾ cm. broad; its edge is toothed and swollen, and its base not covered by any deposit, but ragged and very distinctly reddened; it is surrounded by a greyish-white line, and the whole forms a very striking picture when the mouth is opened. Immediately over this there is a slight brownish-yellow erosion about the size of a pin's head. The tongue is swollen, thickly coated with fur, and reddish-brown on its edges and surface. On the lower surface of the point of the tongue there are two deep ulcers with toothed edges, and covered with a dirty brownish-yellow layer; each is about the size of a small bean. The animal exhales a putrid odour from the mouth. The abdomen is not tender. The appetite is entirely lost, but there is considerable thirst. A short time after having taken water the animal vomited, the vomit being pure water mixed with mucus. No fæces are passed. The fæces adhering to the thermometer are brown, thickish, and not offensive in smell.

On the 4th and 5th September the condition is essentially the same. Inasmuch as the animal vomits all food, it gradually becomes very weak. Up till the evening of the 5th September it is still able to

walk. The temperature, which up till now had remained nearly normal, has sunk to 38·8° C.; the pulse is 79; the respirations 23.

On the morning of the 6th September the animal has become distinctly worse. It comes unwillingly from the place where it is lying, sways when walking, and scarcely takes any notice when called; otherwise no notable alteration is observable. The temperature is 36·8° C.; the pulse is irregular. The urine contains only traces of albumen. In the course of the day the dog has become obviously worse. It lies almost continuously in a state of coma. At 6 P.M. the temperature is 35·7° C.

On the morning of the 7th September the patient was found in a dying state, and death occurred while is was being examined. No important changes have taken place in the mucous membrane of the mouth and tongue. The temperature is 34·9° C.

CASE IV.—(Insidious beginning and course. Late occurrence of ulceration. Death.)

On the forenoon of the 26th October a two-year-old dog was brought by its owner for treatment. On the 23rd of October in the forenoon the animal had eaten badly, vomited, and showed diarrhœa. During the following days the vomiting had continued, occurring after each meal. Whereas the animal had formerly taken its food (milk, soup, scraps from the table), on the 25th of October it entirely lost its appetite. It had become extremely weak and dull, and had lost condition. It had had distemper about a year previously (had discharge from eyes and nose and ate badly). Its condition on the morning of the 26th October was as follows:—

The dog is somewhat emaciated, and gives the impression of great dulness and indifference, but it is still able to walk. Its hair is infested with a large number of fleas. On the abdominal wall there are some red suppurating moist places, but characteristic pustule formation is not recognisable. The conjunctival mucous membrane shows diffuse moderately bright reddening, without any pronounced injection of its vessels. No discharge from the eyes, which appear healthy. The respiratory apparatus is normal in all its parts. The internal temperature is 37·3°. The temperature on the surface of the body is regularly distributed. The heart-beats are distinctly visible on inspection and very irregular; the heart-sounds are normal. The pulse is strong but irregular; pulsations about 140 per minute. The breathing is quiet and 28 in the minute. The mucous membrane of the mouth is moist, much reddened, shining, and swollen, but free from ulceration. On the mucous membrane of the upper lip and cheeks there are scattered ulcers varying in size and form. These are distinctly circumscribed, red in colour, and pressure on them leaves a mark (hæmorrhage). The tongue is swollen and furred; the mouth exhales the odour which is characteristic of a catarrhal affection of the stomach. While under examination the animal vomited a yellowish, watery material mixed with mucus, and without specific odour. The animal does not evince any pain when the abdomen is palpated. Peristalsis is extraordinarily active; close to the animal one can hear clucking or rumbling noises.

In the course of the day the condition has remained practically unchanged. The appetite is entirely suppressed, but there is great thirst. No passage of urine or fæces. At 5 P.M. the rectal tempera-

ture is still 36·9°. Pulse and respirations are practically the same as in the morning.

On the 27th of October there is no material change as compared with the previous day, but the animal appears rather more lively. It moves more freely, and there is less sensorial disturbance. The pulsations of the heart are remarkably strong, being distinctly visible over the whole of the abdomen, and shaking the whole animal. The mucous membrane of the mouth is of a decidedly darker red, but otherwise it shows no striking change. The tongue is limp, thickly furred, and greyish blue in colour. At 8 A.M. the temperature is 36·7°, pulse about 134, respirations 24. At 3 P.M. the temperature is 36·5°, pulse about 133, respirations 25.

The appetite is completely suppressed. Fæces are passed only after the administration of enemata. The fæces show no important abnormality. Urine is passed voluntarily; it is of a yellowish colour, smells like an infusion of flesh, has an acid reaction, and contains neither albumen nor bile pigment.

28th October, 8 A.M. During the night the animal has become decidedly worse. The temperature is 35·8°, pulse 100, respirations 40. The breathing is quiet. Nothing abnormal is detectable on physical examination (no disease of the respiratory apparatus on *post-mortem* examination). In the morning the animal is fouud apparently sleeping. When induced to move it does so with difficulty, and it is very weak and indifferent; it sways and falls when walking, and always endeavours to lie down. When this is permitted it immediately falls into a sleepy condition. The urine drawn with the catheter contains albumen but no bile pigment.

The mucous membrane of the mouth is uniformly of a brownish-red colour and dry. On the mucous membrane of the upper lip, and at some places also on that of the cheeks, there are small erosions varying in depth, and opposite the incisor teeth there are some specially distinct ulcers, prominent on account of their depth and the dirty greyish-yellow material which covers them.

In the course of the forenoon the animal quickly became worse. It lies continuously in a state of coma. The lesions on the mucous membrane of the mouth remain as before, but the tongue has become of a brownish-black colour, as if gangrenous. About 2 P.M. the pulse can scarcely be felt, and the temperature has sunk below that of the thermometer scale. Shortly afterwards the animal died without convulsions.

CASE V.—(Pseudo-paralytic condition. Recovery.)

On the 31st October a six-year-old dog was brought by its owner to the Clinique here.

History.—The owner asserts that, apart from an attack of distemper from which it suffered about half a year ago, the animal has always been healthy and lively, and has taken its food well. Three days ago it vomited repeatedly, ceased to eat, was very dull, did not hear when called, and since yesterday appeared to be paralysed behind.

Present Condition.—Animal moderately well nourished, of medium build, coat in good condition; no abnormalities in connection with the skin or lymphatic system. The conjunctival mucous membrane shows a diffuse moderate reddening, and its vessels are distinctly injected. No discharge from the eyes, which appear to be normal.

Nothing abnormal is discoverable in connection with the respiratory apparatus, but the nose is dry. The respirations are 38 in the minute. In connection with the circulatory apparatus nothing is to be noted beyond an increased frequency of the pulse (120 per minute). There is an unusually strong pulsation of the heart visible over a large area. The temperature over the surface of the body is regular, and the internal temperature is 39·2°. There are no convulsions, but the animal appears to be paralysed behind. It is unable to support itself on its hind legs, and sensation appears to be greatly diminished. At every place only a weak reaction is obtained when the animal is pricked with a pin. The reflexes are normally present.

The mouth exhales a nasty, but at the same time not very strong, odour. The mucous membrane of the mouth is all over of a reddish-brown colour and dry. There are no distinct ulcers, but only some erosions on the mucous membrane of the upper lip on either side opposite the corner incisor teeth ; these are raised, irregular in shape, and surrounded by a red border about 1 mm. in breadth. Towards their centres they are of a yellowish-brown colour ; the one on the left side is about the size of a pea, and that on the right about the size of a bean. Opposite the upper incisor teeth the mucous membrane of the lip also shows some red spots varying in shape and size, and here and there it is eroded. The tongue is furred and swollen, and its edges are brownish red. Raw flesh, cocoa, etc., is refused. While under examination the animal repeatedly vomited a yellowish-green frothy material. The abdomen is moderately tense and somewhat tender. Passage of fæces and urine not observed.

1st and 2nd November. No improvement. The animal frequently vomits spontaneously, and it does so every time that anything is administered to it by the mouth. The fæces passed with enemata are brownish yellow, but otherwise show nothing remarkable. The urine contains abundance of albumen. Up to the evening of the 2nd November the temperature, pulse, and respirations showed a decline, as follows :—

1st November,	8 A.M.	Temperature	39·1°,	pulse	118,	respirations	30.
„ „	6 P.M.	„	38·8°,	„	110,	„	26.
2nd „	8 A.M.	„	38·5°,	„	100,	„	24.
„ „	6 P.M.	„	36·7°,	„	60,	„	18.

On the evening of the 2nd November the animal was livelier. It made attempts to stand, and the hind-quarters were decidedly stronger. Vomition had ceased, and the appetite had improved. The ulcers showed the same appearance, but no new ones had formed.

3rd November, forenoon. The animal is distinctly better. It can support itself on its hind legs, but these frequently give way when it walks. Sensation is much more acute, and the ulcers are in process of healing. On the mucous membrane opposite the left upper molar teeth some circumscribed, red, and rather deep spots have formed. Temperature 37·1°, pulse 68, breathing 20. Still traces of albumen in the urine. Up till the evening vomition has not been observed. At 6 P.M. the temperature is 37·4°, pulse 72, respirations 26.

From the 4th of November the condition of the animal visibly improved. The ulcers gradually disappeared, without previously

undergoing any change for the worse. The mucous membrane of the mouth and tongue resumed its normal colour. On the 8th of November the animal was so far recovered that it could be sent home.

CASE VI.—(Severe case. Recovery.)

The patient in this case was a dog which, on the 29th of October, without previous signs of disease, suddenly began to vomit its food, consisting of scraps from the table. From this time onwards the vomiting was frequently repeated, especially after taking food. Up to the 5th of November the vomiting had not quite ceased, but the animal took soup and flesh, though not with its former appetite. It refused milk, however, of which it had previously been fond. After the 5th of November the animal ate nothing, quickly became emaciated, and could go at the most only twenty or thirty steps, although it no longer vomited. The owner did not know whether the dog had had distemper or not. When questioned he said that it had not had any discharge from the eyes or nose. No information was obtainable as to the state of the bowels. When his attention was called to the formation of tartar on the teeth, the owner said decidedly that this had occurred during the course of the disease. The animal was brought to the Clinique on the 8th of November.

The patient is a fox-terrier dog, emaciated but strong, and with coat in good condition. It is very dull and depressed, lies much, scarcely takes any notice when called, and sways in walking. The general integument and the lymphatic apparatus as far as it is accessible to examination are normal. The conjunctiva of the eyelids is bright red and much injected; the eyeballs are sunk in their sockets, but show no disease to ordinary examination or with the ophthalmoscope. No discharge from the eyes; no abnormality in connection with the respiratory apparatus. Internal temperature, 38·2°, surface temperature uniform. The pulse is 150 per minute and very small, but not abnormal in rythm or quality. The respirations are 36 in the minute. When the mouth of the animal is forcibly opened it exhales a cadaverous odour. The mucous membrane appears brownish-red, chocolate-coloured, and dry. The tongue is lead coloured and thickly furred; when pressure is exerted on its tip it is slowly moved. The gums immediately surrounding the teeth are blood red and retracted; at some places, especially around the right upper canine tooth, the gum is ulcerated. On the upper lip, stretching from one canine tooth to the other, there are a number of erosions up to the size of a bean; most of these are elevated, surrounded by a red seam, and of a brownish-yellow colour in their centres. A few of them, however, have become ulcerated in the centre, and are covered by a dry spongy layer. The mucous membrane opposite the incisor teeth shows distinct deep ulceration; there are also some deep, grey-edged, irregular ulcers over the tonsils, and some smaller erosions towards the angle of the jaw. The edges of the tongue, especially towards the point, are beset with numerous erosions. The mucous membrane of the soft palate and pharnyx is of a diffuse brownish-red colour, but it is not ulcerated. The region of the stomach is not notably tender.

The urine has an acid reaction, and contains a rather large quantity of albumen and bile pigment. The appetite for food is entirely sup-

pressed, but the animal frequently drinks chamomile tea with white of egg. In the course of the afternoon the animal passed several times, with severe straining, a quantity of bloody, watery fæces, having an abominable stench. No vomition.

6 P.M.—Temperature 37·4°, pulse 140, respirations 36.

9th November, 8 A.M. The animal is very dull and scarcely takes any notice when called. The temperature is 36·8°, pulse 170, respirations 28. Later the condition of the animal had improved (as the result of treatment?). The animal takes chamomile tea with egg, and also grated flesh in small quantities often repeated, without any vomition. At 6 P.M. the temperature had risen to 37·6°, pulse 160, respirations 26.

10th November, 8 A.M. To-day there is a decided improvement. The animal is livelier and takes grated meat and cocoa. Occasionally it passes fæces which contain blood, but are firmer in consistence. No vomiting. Temperature 38·4, pulse 150, respirations 22. For the first time an improvement in the ulcers has set in. The smell still continues; the urine contains only traces of albumen, but a large quantity of bile pigment.

11th November, 8 A.M. Improvement maintained. The patient is lively and eats almost greedily; the ulcers are healing beautifully; the smell has diminished. The diarrhœa still continues, and also the marked redness of the mucous membrane of the mouth. No vomiting. Temperature 38·4°, pulse 115, respirations 24.

From the 12th of November onwards the condition steadily improved. While on the 14th of November the ulcers had already healed, and the mucous membrane of the mouth and tongue had become almost normal, the passage of blood with the fæces obstinately continued, and even on the 21st of November, when the animal was taken home, there was an occasional occurrence of diarrhœa, with bloody, semi-fluid, stinking fæces, although the general condition of the animal was very good. The urine was free from albumen but contained bile pigment.

The diagnosis when the disease is completely developed offers no difficulty. Attention may be called to the constancy and early occurrence of the characteristic symptoms of the disease. Prominent amongst these is the constant and sudden onset of vomiting, accompanied by complete loss of appetite, and followed by great weakness and eventually by a soporous condition of the animal. In eliciting the previous history all these points deserve the closest attention. In most cases it is quite unnecessary to question the owner as to the occurrence of these important symptoms, since, owing to the unexpected and generally very severe onset of the disease, it is practically impossible to overlook them. In the great majority of cases the owner will mention the above-described symptoms one after another, now and again with expressions of great astonishment regarding the incredibly sudden transition from health to illness. We were ourselves astonished at the stereotyped history given by the owners, and it sufficed to take a brief glance at the sclerotic and into the cavity of the mouth, or to raise the upper lip opposite the canine teeth, to arrive at a diagnosis. On the sclerotic the never failing and very striking injection of its vessels,

and in the mouth the unmistakable discolouration of the mucous membrane and the formation of ulcers, serve to make the diagnosis certain. Now and again the person bringing the dog supplies further details, such, for example, as that its mouth has a most abominable stench, and on this statement alone it may with the greatest probability be concluded that the animal is affected with the disease in question. Two statements which are quite characteristic in connection with the disease may here be mentioned.

A gentleman brought his dog with the usual report that it had suddenly began to vomit, refused to eat, showed quite a changed general appearance, and that the "dog's mouth was in a state of corruption." In another case the owner asserted that her "dog's tongue had shrivelled up and was now as thin as paper."

The diagnosis is rather more difficult when the characteristic symptoms in connection with the mouth and eyes first set in at a later stage in the disease. This certainly occurs rather rarely. In such cases the discolouration or the formation of ulcers in connection with the mucous membrane of the mouth, throat, or tongue, and the onset of marked injection of the conjunctival vessels must be awaited before a positive diagnosis can be made, although the previous history may suggest the presence of the disease, and even make its existence highly probable.

It must be distinctly understood that in all the cases which have come under our observation the chief importance has been attached to these objective alterations, and next to that to the absence of a catarrhal discharge from the eyes and nose, or to the absence of disease of other mucous membranes, with the exception of that of the digestive apparatus, even when the previous history and the other abnormalities presented by the animal pointed to this disease. Only when these objective changes were present was the disease diagnosed as the Stuttgart dog epizootic. In saying this it is not denied that the disease may occur in other forms without these characteristic alterations, as, for example, under the form of a simple gastro-enteritis, and on the other hand, it is possible that cases of the latter were referred to the affection now under consideration, as may easily happen in dealing with the plague-like occurrence of a disease. We believe that ordinary gastro-enteritis, which we met rather frequently along with the other disease in old animals, and which ordinarily ended in recovery, ought not to be included, for as yet in isolated cases a clinical distinction can be made only in the presence of the characteristic symptoms already mentioned, and when these are absent and there is perhaps a slight degree of catarrh of the stomach and intestines, the case is set down as belonging to the Stuttgart disease.

The course of the disease is acute, seldom peracute; as a rule it does not exceed ten days. In most cases death results early, on an average in the first four or six days.

In cases that recover the whole course of the disease is about from thirteen to fifteen days. In all cases but one the recovery was complete. and in the exception the animal when it left retained no symptom of disease except an obstinate and occasionally bloody diarrhœa. The occurrence of any secondary diseases was not observed. In those cases in which during the course of the disease there were symptoms

pointing to involvement of the nervous system, in the form of clonic contractions or pseudo-paralytic conditions in the hind-quarters, these gradually declined as the animal improved, and eventually entirely disappeared. In fatal cases death is fore-shadowed by rapid emaciation and by the animal falling into a comatose condition, which only in a few cases is interrupted by clonic contractions of all the muscles of the body.

The prognosis of the disease is unfavourable, inasmuch as most cases terminate in death. Of the forty-two patients treated in the Clinique, thirty-two died, and only ten were sent out cured. The death-rate was thus 76·2 per cent. Inspection of the list of recoveries shows that upon the whole there was a slighter mortality among younger animals; for example, out of three patients under a year old two recovered. With regard to the severity of the disease, a more benign course is also generally observable in young animals. In them, as a rule, the appetite was not entirely suppressed, and the vomiting was repeated at longer intervals. As a result of this, the loss of strength consequent upon the inability to take food and drink did not set in so quickly as was usually the case with older animals. In them also there was less ulceration, and the chief characteristics of the disease were the peculiar brownish-red chocolate colour of the mouth and pharynx, the peculiar discolouration of the tongue, and the striking dryness of all the visible mucous membranes. In all cases, however, injection of the vessels of the sclerotic was present, and although there was no fully developed ulceration there were almost always more or fewer erosions, accompanied by circumscribed hyperæmia or hæmorrhages, especially in the neighbourhood of the mucous membrane opposite the incisor teeth. Youth of the patient must therefore be regarded as in its favour, and a slow onset with slight intensity of the morbid processes constitutes the most important factor from which to foretell a favourable course for the disease. On the other hand, a rapid development of the disease constitutes an unfavourable sign. Continual vomiting, complete loss of appetite, profuse diarrhœa, rapidly occurring exhaustion, weakness, depression, emaciation, early and extensive ulceration, coma, pneumonic complications, and subnormal temperature, when occurring in old animals, are almost infallible indications of a fatal ending.

The course of the disease is not at all dependent upon the animal's constitutional tendency. It carries off both weakly low-conditioned animals and those which were well built and well nourished before they were attacked. Indeed one is almost compelled to believe that the disease claims its victims mainly from among the strong well-developed dogs. Nor is the disease in any way dependent upon breed, for although some breeds have furnished a larger number of cases and a greater proportion of fatalities than others, this ought not to be ascribed to any special susceptibility, but rather to the fact that a larger number of the dogs in this city belong to the breeds in question. This is also the explanation of the fact that a larger proportion of the animals were males. Of the forty-two patients treated in the hospital and the fifty-eight treated outside, between the 13th of August and the end of December, only two belonged to the female sex.

The hundred cases were distributed as follows according to breed :—

Schnauzer	21
Pointer	16
Pinscher	16
Poodle	10
Dachshund	9
Fox-terrier	8
Setter	4
German mastiff	4
Leonberger	3

Other nine breeds furnished one case each.

As the following table shows, most of the animals were aged :—

Age.	*Number.*	*Age.*	*Number.*	*Age.*	*Number.*
5 months	1	2½ years	2	9 years	2
9 "	1	3 "	19	10 "	6
10 "	1	4 "	11	11 "	...
1 year	2	5 "	11	12 "	1
1½ years	4	6 "	9	13 "	1
1¾ "	1	7 "	7	14 "	2
2 "	11	8 "	7	15 "	1

According to the months, the cases were distributed as follows :—

August	14
September	32
October	30
November	17
December	7

It will thus be seen that the disease reached its height in September. A distinct decline was observable in November, and the figures show that in December and January the plague was gradually disappearing.

The characteristic clinical symptoms and the mode in which the disease occurs leave no room for doubt as to its nature. Apart from the lesions in the mouth, etc., the complete suppression of appetite, the vomition, the quantity of the vomit, together with its macroscopic and microscopic characters, the greatly increased thirst, the pronounced tenderness in the region of the stomach on palpation, all point unmistakably to the stomach being the special seat of disease. The constipation and diarrhœa, and the detection of bile pigment in the urine, show that the intestine is in a greater or less degree involved in the disease, and the appearance of the fæces indicates the special nature of this affection of the intestines. The considerable degree of disturbance of general health, the large quantity of albumen

which is usually present, and the course of the disease, are sufficient indications of its gravity. Finally, the occurrence of a large number of cases with practically identical symptoms and lesions speaks in favour of the disease being an infectious one.

The Stuttgart dog epizootic may thus be defined as a severe contagious and infectious disease which runs a typical course, and attacks almost exclusively the digestive apparatus in the form of a gastritis (usually hæmorrhagic), but which more rarely has enteritis and ulcerative inflammation of the mouth for complications. (Gastro-enteritis hæmorrhagica contagiosa et stomatitis ulcerosa canum.)

Up to the present time a search for the cause of the infection and the experiments which have been made have not yielded decisive results. In the meantime, therefore, opinions regarding this point are of the nature of hypothesis.

With regard to the pathology of the disease, we are inclined to think that probably the agent of infection enters the body by way of the digestive organs. What is the precise point of penetration, and whether the germ first gets into the blood stream and thus determines a general infection of the blood, followed secondarily by the development of lesions in the digestive apparatus, is not easy to decide, although this appears to be possible from the generally severe clinical symptoms, which now and again are not at all proportional to the lesions found at the *post-mortem* examination. Probably the causal agent settles in the mucous membrane of the stomach or intestine, excites there a local lesion, and floods the blood with its metabolic products, these causing the convulsions as well as the rapidly ensuing depression and the soporous condition, and being assisted in their action by the effects of the total abstinence from food. Beyond any doubt the heart is soon in a high degree affected, with diminution of the functional power of the heart muscle as a consequence. To this, and probably also in part to alteration of the blood, the striking discolouration of the visible mucous membranes is due. It is very difficult to decide as to the mode of formation of the ulcerating lesions in the cavity of the mouth. In my opinion, only very slight importance in this respect can be attached to the inanition, since the ulcers frequently develop in cases in which there is only very slight enfeeblement. With respect to the ulcers in the throat, some specific effect appears to be added to the causal agent in determining the development of the ulcerative process. The chief cause of the ulceration, however, is certainly the pressure of the hard organs of the mouth on the badly nourished buccal mucous membrane. This is indicated by the typical behaviour of the ulcers, as well as by the observation, which was early made, that the ulcers can be produced artificially. On account of the difficulty which was now and again encountered in opening the mouth with the hand, tapes were applied in the well-known way behind the canine teeth of the upper and lower jaws, and by traction on these the animal's mouth was forcibly opened. In consequence of this, and as a result of the pressure and friction of the tapes, ulceration of the mucous membrane was frequently set up. In one case shortly after digital exploration of the rectum a necrotic degeneration of the mucous membrane developed. It is in the highest degree probable that the further course

of the ulceration is assisted by the specific causal agent as well as by the penetration of facultative parasitic bacteria.

It appears probable that the virus is of a fixed character, and contained principally in the fæces and vomit of diseased animals, possibly also in the urine, the blood, and the other tissue juices. It is questionable whether it is present in a fluid condition in the expired air, etc. Although up to the present time the actual mode of transmission of the virus has not been definitely determined, it cannot be doubted that direct infection from animal to animal, in consequence of licking, etc., takes place, and it is also certain that the disease may be transmitted by intermediary bearers of the most varied kind, such as water, food, persons, and objects of all kinds. The spontaneous development of the causal agent is, of course, out of the question.

From what locality the disease was introduced into Stuttgart is difficult to determine. Apparently the same disease was recently observed in other towns (Frankfurt, Hamburg, and Wiesbaden). To my knowledge, however, the disease first prevailed in Stuttgart, from which it appears to have been carried to these other towns. It has been suggested that the disease was spread by dogs which, shortly before the disease broke out in epizootic form, had been exhibited in a dog show in Stuttgart. As a matter of fact, it is said that some of the animals there were seized with striking symptoms. Our inquiries, however, with regard to that matter did not elicit such corroboration as is desirable in the investigation of such points, and hence this question still remains in obscurity.

RESULTS OF THE APPLICATION OF THE TUBERCULIN TEST TO HER MAJESTY'S DAIRY COWS AT WINDSOR.

By J. M'FADYEAN, Principal of the Royal Veterinary College, London.

AT a meeting held at Marlborough House on Tuesday, the 20th December last, to further the objects of the National Association for the Prevention of Consumption and other forms of Tuberculosis, His Royal Highness the Prince of Wales mentioned that Her Majesty the Queen had given authority to destroy thirty-six out of forty of her dairy cows at her Home Farm, because on being tested by tuberculin they had been found to be tuberculous. This statement obtained wide publicity, and it has naturally excited a great deal of interest among owners of cattle and others who are specially concerned in the eradication of tuberculosis from dairy stock. On several occasions a desire has been expressed for fuller information regarding the matter, and official sanction has been given to the publication of the following detailed account of the circumstances in question.

The animals tested formed the herd of unpedigreed cows kept for the supply of milk at Her Majesty's Home Farm at Windsor. These animals were under the veterinary care of Messrs Allnutt & Tennant, Veterinary Surgeons, Windsor, and the whole of them were in good condition and apparently healthy. Notwithstanding this, it occurred

to those responsible for the management of the herd that, in view of the accumulated evidence of the accuracy of the indications afforded by tuberculin, and the desirability of excluding from the herd every animal affected with tuberculosis, however slightly, the whole of the cows ought to be tested. Professor Sir George Brown, C.B., when consulted supported this view, and the test was accordingly carried out on the 15th and 16th of September 1897.

The temperatures of all the animals had been taken by Mr Tennant on the 14th September, and with one exception they were then normal, or at least under 103° F. The exception was the cow "Snowball," No. 32 in the following list, and her temperature was 104°.

The tuberculin was injected on the 15th September, commencing at 11 A.M. The temperature of each animal was taken just before it was operated upon, and again at the third, sixth, ninth, twelfth, and fifteenth hour afterwards.

When the temperature charts were examined on the 16th September it was found that, accepting a gradual rise of temperature from the normal to 104° or more as evidence of the existence of tuberculous disease, at least thirty-two of the cows appeared to be affected, while only five could be pronounced healthy, and the remainder doubtful.

To retain the animals that had reacted in the herd was undesirable, and it was therefore decided that the whole of these should be killed and submitted to a searching *post-mortem* examination.

Subsequently it was thought that the observations made on the reacting animals would have a greatly enhanced value if the non-reacting animals and those in which the reaction appeared doubtful were also submitted to a careful search for evidence of disease after death, and, accordingly, the whole of the cows were killed and examined at the Royal Veterinary College within a few weeks after they had been tested. The results are set forth below.

No. 1.—Jersey, "Marionette."

Temperature.—103°, 101°, 101·3°, 104°, 106°, 105·2°.[1]

Autopsy.—Bronchial and mediastinal glands much enlarged, the latter as large as the fist, and caseating. The right lung contains three areas of caseating broncho-pneumonia. Hepatic lymphatic glands contain caseous tubercles. One mesenteric gland contains caseating tubercles.

No. 2.—Jersey, "Surprise."

Temperature.—103·1°, 101·4°, 102°, 105·4°, 106·3°, 105·8°.

Autopsy.—Bronchial and mediastinal glands much enlarged, and full of caseating tubercles.

No. 3.—Jersey, "Bosis."

Temperature.—101°, 100·8°, 101·4°, 104°, 104·7°, 104·9°.

Autopsy.—Bronchial and mediastinal glands much enlarged, caseous, and calcified. The mediastinal gland is as thick as one's wrist, and about 6 inches long. Several areas of broncho-pneumonia in the right lung. A fringe of "grapes" along the edge of the left lung, and similar growths on the diaphragm. Hepatic lymphatic glands contain yellow tubercles. Nearly the whole of the mesenteric glands contain distinct tubercles.

[1] The temperatures given for each animal are those recorded at the time of injection, and at the third, sixth, ninth, twelfth, and fifteenth hours afterwards.

No. 4.—Jersey, "Polly's Pet."

Temperature.—101·8°, 102·4°, 103·4°, 106·6°, 105·8°, 105·2°.

Autopsy.—Left and right bronchial glands and mediastinal glands contain yellow tubercles. The right fore quarter of the udder contains a fœtid abscess as large as the fist.

No. 5.—Shorthorn, "Alex."

Temperature.—102·2°, 102°, 103·3°, 106°, 107·5°, 105·6°.

Autopsy.—Right bronchial gland contains yellow caseous tubercles; mediastinal ditto and partly calcified. Small echinococcus cyst in right lung. A portion of the right posterior quarter of the udder is in a condition of acute non-tuberculous inflammation.

No. 6.—Shorthorn, "Jenny."

Temperature.—102·6°, 101·6°, 102·6°, 104°, 105·8°, 106·7°.

Autopsy.—Bronchial and mediastinal glands enlarged and caseating. One small pea-sized area in the right lung commencing to caseate.

No. 7.—Shorthorn, "Cherry."

Temperature.—101·2°, 100·8°, 102°, 103°, 103·8°, 103·8°.

Autopsy.—Bronchial and mediastinal glands contain a few yellow tubercles. Numerous echinococcus cysts in the lungs. Left kidney contains an echinococcus cyst about the size of a pigeon's egg. Liver contains numerous echinococcus cysts.

No. 8.—Shorthorn, "Honesty."

Temperature.—101·4°, 102·2°, 103°, 105·4°, 105·1°, 103°.

Autopsy.—Bronchial and mediastinal glands enormously enlarged and caseous. Over the heart a gland is as large as a cocoa-nut, and the mediastinal gland is as large as an ox kidney. Numerous areas of tuberculous broncho-pneumonia in each lung. A pharyngeal gland on each side is as large as a turkey egg, and softened centrally. Hepatic lymphatic glands enormously enlarged—four times as large as the fist—caseating, and softened. About the half of the mesenteric glands contain caseating tubercles.

No. 9.—Jersey, "Cloud."

Temperature.—101°, 101·6°, 102·5°, 104·9°, 105·8°, 105·5°.

Autopsy.—Mediastinal gland contains yellow tubercles. Pharyngeal glands on both sides contain tubercles.

No. 10.—Jersey, "Mayflower."

Temperature.—101·5°, 102·6°, 103·1°, 103·4°, 106°, 104·2°.

Autopsy.—Right bronchial gland enlarged and caseating. One small (pea-sized) distinctly caseating lesion in the right lung. Pharyngeal glands on both sides enlarged to size of pullet's egg, and one on each side caseating.

No. 11.—Jersey, "Tulip."

Temperature.—101°, 101°, 102·2°, 104·4°, 106·7°, 104·9°.

Autopsy.—Bronchial glands on both sides contain caseous tubercles. Mediastinal glands much enlarged and caseating. All the pharyngeal glands somewhat enlarged; one on each side caseous. Three of the mesenteric glands enlarged, caseating, and calcified.

No. 12.—Shorthorn, "Fawsley."

Temperature.—102·2°, 101·9°, 103·7°, 105·4°, 106°, 105·2°.

Autopsy.—Right bronchial gland enlarged and caseating; a single yellow tubercle in the left bronchial gland.

No. 13.—Shorthorn, "Beauty."

Temperature.—103°, 103·8°, 103·1°, 104°, 106·2°, 106·2°.

Autopsy.—Right bronchial gland enlarged and caseating; also one or two yellow caseous nodules in mediastinal glands.

No. 14.—Jersey, "Bustle."

Temperature.—102·6°, 106·5°, 107°, 106·7°, 107·6°, 106·2°.

Autopsy.—Mediastinal glands very much enlarged—as thick as the wrist. Two areas of caseating broncho-pneumonia in the right lung; one ditto in the left lung. Pharyngeal glands somewhat enlarged, but not distinctly caseous.

No. 15.—Jersey, "Bonny."

Temperature.—101·6°, 102·7°, 102·2°, 103·1°, 105·8°, 104°.

Autopsy.—Left bronchial gland enlarged and filled with caseous nodules. Several yellow nodules in the mediastinal gland.

No. 16.—Jersey, "Pearl."

Temperature.—102°, 102·9°, 104·9°, 107·6°, 105·8°, 105·8°.

Autopsy.—Left and right bronchial and mediastinal glands enlarged and caseating.

No. 17.—Shorthorn, "Betty."

Temperature.—101·5°, 101·6°, 102·4°, 104·9°, 106·2°, 105·8°.

Autopsy.—Right bronchial and mediastinal glands contain caseous and calcified lesions. Area of caseating broncho-pneumonia in right lung. One mesenteric gland caseous and calcified.

No. 18.—Shorthorn, "Nell."

Temperature.—101°, 101·2°, 101·5°, 105·8°, 104·9°, 102·3°.

Autopsy.—The left fore quarter of the udder contains a spherical necrotic mass about as large as a walnut, and surrounded by a fibrous capsule. The surrounding gland tissue is perfectly normal. Lymphatic glands of the udder normal. Right lung contains three areas of tuberculous broncho-pneumonia, the largest the size of a hen's egg. The left contains two such areas, the largest about the size of a hen's egg; all are extensively caseated. Liver contains several echinococcus cysts, one partially calcified. Two of the mesenteric glands contain numerous caseating tubercles.

No. 19.—Shorthorn, "Primrose."

Temperature.—102°, 101·6°, 102·2°, 101·3°, 101·3°, 105·8°.

Autopsy.—No tuberculous lesions were found in this animal. The uterus contained about a quart of turbid, non-putrid liquid, and its mucous membrane was inflamed. A cyst as large as the fist was present on the course of the left Fallopian tube.

The following glands and organs were minutely examined:—The lungs, liver, kidneys, spleen, and udder; and the pharyngeal, prescapular, prepectoral, bronchial, mediastinal, suprasternal, mesenteric, hepatic, gastric, precrural, popliteal, and supramammary lymphatic glands.

No. 20.—Jersey, "Lily."

Temperature.—101·4°, 101·4°, 101·7°, 104·6°, 106°, 103·1°.

Autopsy.—Bronchial and mediastinal glands much enlarged and caseous. Several areas of caseating broncho-pneumonia in the right lung. One parasitic cyst in the left lung. Pharyngeal glands enlarged, but not caseating. The liver contains a fibrous nodule about the size of a walnut, with suppurating or caseous centres in it, and at the left extremity of the liver there are two similar lesions. A splenic lymphatic gland is indurated and caseating.

No. 21.—Jersey, "Julia."

Temperature.—101·8°, 101·4°, 103·2°, 105·2°, 105·7°, 105·1°.

Autopsy.—Mediastinal gland enlarged and caseating. Right lung contains one pea-sized caseating area of broncho-pneumonia; the left lung contains a similar area about as large as a hen's egg. The bronchial glands are enlarged, one of them to the size of a turkey egg; the latter is extensively softened, and contains a yellow custard-like material. One caseating tubercle in a mesenteric gland.

No. 22.—Jersey, "Bonbon."

Temperature.—101·4°, 101·4°, 101·8°, 104·6°, 106°, 105°.

Autopsy.—Bronchial gland on right side caseated almost throughout; mediastinal gland also contains some yellow tubercles. One caseating broncho-pneumonic area in right lung. A pharyngeal gland on the right side is enlarged to the size of a goose egg, cirrhotic, and filled with caseating tuberculous nodules.

No. 23.—Jersey, "Jessie."

Temperature.—101°, 100·6°, 101·1°, 104°, 106°, 105°.

Autopsy.—Tubercles in both bronchial glands and in mediastinal gland. Two tuberculous broncho-pneumonic areas in the right lung, each about the size of a hazel nut; the left lung contains about half-a-dozen such areas. The hepatic lymphatic glands contain caseating yellow tubercles. One partially degenerated echinococcus cyst in the liver. Two mesenteric glands contain numerous caseating tubercles.

No. 24.—Jersey, "Molly."

Temperature.—102°, 102·2°, 104°, 106·7°, 105·8°, 105·8°.

Autopsy.—Bronchial glands both caseating—the left as large as a goose egg. Mediastinal gland enlarged and caseating. The left lung contains a caseating area about as large as a hen's egg, and another about as large as a walnut.

No. 25.—Jersey, "Milkmaid."

Temperature.—101·8°, 102·6°, 102°, 101°, 101°, 101°.

Autopsy.—No tuberculous lesions found.

No. 26.—Jersey, "Mirror."

Temperature.—101°, 101·4°, 102·3°, 102·4°, 104°, 101·2°.

Autopsy.—Caseous tubercles in left bronchial and mediastinal glands. One caseous tubercle about the size of a hazel nut in left lung.

No. 27.—Kerry, "Brownie."

Temperature.—101·6°, 101·4°, 101·4°, 101·4°, 102·4°, 104·3°.

Autopsy.—Right bronchial gland enlarged to the size of a walnut; with the exception of a thin capsule it is entirely caseous and softened.

No. 28.—Shorthorn, "Brocade."

Temperature.—101·8°, 101·4°, 101·2°, 101°, 101·2°, 103·6 .

Autopsy.—Some small caseous tubercles in the left bronchial gland. Large fœtid abscess at the portal fissure of the liver.

No. 29.—Shorthorn, "Sally."

Temperature.—101·6°, 102°, 102·5°, 101·7°, 101·2°, 98·6°.

Autopsy.—No tuberculous lesions were found in this animal.

No. 30.—Shorthorn, "Rosebud."

Temperatare.—101°, 101·2°, 101·4°, 100·2°, 99·8°, 100·4°.

Autopsy.—The mediastinal lymphatic gland contained a pea-sized caseous nodule. Microscopic examination showed fairly numerous tubercle bacilli in the caseous material.

No. 31.—Shorthorn, "Judy."

Temperature.—101·6°, 100·8°, 103·4°, 100·8°, 100·8°, 100·4°.

Autopsy.—No tuberculous lesions discovered.

No. 32.—Shorthorn, "Snowball."

Temperature.—102°, 103·1°, 102·6°, 103·1°, 105·8°, 105·8°.

Autopsy.—Yellow caseous tubercles in both bronchial and mediastinal glands. Small focus of broncho-pneumonic tubercle in base of right lung. Liver cirrhotic from flukes. Several mesenteric glands enlarged and caseating.

No. 33.—Jersey, "Trophy."

Temperature.—101·8°, 101·6°, 101·8°, 101·4°, 103·2°, 104°.

Autopsy.—Caseous tubercles in both bronchial and mediastinal glands. Small caseating area in the right lung.

No. 34.—Shorthorn, "Strawberry."

Temperature.—102·2°, 101·8°, 102·8°, 104·5°, 106·7°, 106·4°.

Autopsy.—A few tubercles in the right bronchial gland.

No. 35.—Shorthorn, "Mary."

Temperature.—101·4°, 101·6°, 102·4°, 101·3°, 103·5°, 104°.

Autopsy.—One caseous tubercle about the size of an oat-seed in the mediastinal gland. The mammary gland on both sides is the seat of suppurative inflammation, and in the left half there is a large abscess with thick yellow pus. Mammary lymphatic glands on both sides normal.

No. 36.—Jersey, "Rosit."

Temperature.—101°, 101·6°, 103·1°, 105·8°, 106°, 105·8°.

Autopsy.—Caseating tubercles in left bronchial gland and in mediastinal gland.

No. 37.—Shorthorn, "Nelly."

Temperature.—102°, 103°, 103·1°, 107·6°, 106·7, 105·8.

Autopsy.—Tubercles in bronchial glands on both sides. An area of broncho-pneumonic tubercle in the left lung and also a degenerated echinococcus cyst. Yellow caseating, partly calcified, tubercles in two mesenteric glands.

No. 38.—Shorthorn, "Dolly."

Temperature.—101·4°, 101·8°, 105·3°, 106·2, 105·8°, 104°.

Autopsy.—Bronchial and mediastinal glands much enlarged, caseating, and partly calcified. Numerous grapy growths on the right pleura. Numerous areas of caseating nodular tuberculous broncho-pneumonia in each lung. At one extremity of the spleen a good deal of inflammatory fibrous tissue has been formed, and at the centre of this, but not involving the splenic substance, there is an abscess with thick yellow pus. Both surfaces of the diaphragm are studded with grapy growths, largest and most numerous on the pleural surface. Nearly all the mesenteric glands contain caseating tubercles. The left supramammary lymphatic gland is indurated and contains several caseous and partly calcified tuberculous nodules, the largest as large as a hazel nut; no trace of tuberculosis in any part of the udder.

No. 39.—Shorthorn, "Bertha."

Temperature.—101·8°, 102·7°, 102·6°, 103·1°, 105·8°, 104·9°.

Autopsy.—The left bronchial lymphatic gland contains one tubercle, partially calcified.

No. 40.—Shorthorn, "Hope."

Temperature.—101°, 102·2°, 102·4°, 102·2°, 104·9°, 106·7°.

Autopsy.—Yellow tubercles are present in bronchial and mediastinal glands and in one mesenteric gland.

In interpreting the results of an injection with tuberculin it is customary to regard a rise of temperature from the normal (about 102°) to 104° or over during the fifteen hours following the operation as evidence of tuberculosis, and to consider those animals in which there is practically no disturbance of temperature within that time as free from tuberculosis.

Analysing the foregoing details, it will be seen that in thirty-four of the animals the temperature rose to 104° or more, and thirty-three of these were found to be tuberculous on *post-mortem* examination.

In the remaining animal (No. 19 in the list) no tuberculous lesion could be found, but the uterus was diseased. It will be observed that in this animal, although the temperature rose to 105·8°, the rise was sudden and did not occur until after the twelfth hour. Probably the disturbance of temperature in this instance was connected with the uterine disease, and the case illustrates one of the possible sources of error in the use of tuberculin.

In four of the animals (Nos. 25, 29, 30, and 31) the temperature remained practically undisturbed[1] during the fifteen hours after the operation, and, with the exception of No. 30, these cows appeared to be free from tuberculous disease on *post-mortem* examination.

Lastly, two of the animals (Nos. 7 and 28) had to be classed doubtful, the temperature rising in the one case to 103·8°, and in the other to 103·6°. Tuberculous lesions were found in each of these cows after death.

The fact that such a large proportion of the cows in Her Majesty's dairy herd had become tuberculous illustrates a point which it is all important to keep in mind in devising measures for the prevention and suppression of the disease. The premises in which these cows were kept are probably the best in the kingdom from the point of view of cubic space, light, and ventilation, and in respect of cleanliness they left nothing to be desired. Nevertheless, the disease had attacked thirty-six out of the forty animals. From this it may be inferred that tuberculosis among dairy cattle cannot be successfully attacked by simply insisting upon a cubic capacity of 800 feet per animal in the cow-sheds. There is only one way of keeping housed cattle free from tuberculosis, and that is to see that no tuberculous animal is admitted among them. That plan has been adopted in creating a new dairy herd at Her Majesty's Home Farm, all the animals purchased for it being tested by tuberculin and admitted only when they do not react.

[1] It will be observed that in No. 31 the temperature reached 103·4°, but this was at the sixth hour only, and the rise was obviously accidental.

EDITORIAL ARTICLES.

THE STAMPING OUT OF TUBERCULOSIS.

As time advances, and information regarding the prevalence of the disease is accumulated, the difficulty, not to say the impossibility, of eradicating tuberculosis from among the domesticated cattle of this country becomes more and more apparent. The difficulty of diagnosis, which before the discovery of tuberculin stood as an insuperable barrier to stamping-out measures, has now almost entirely disappeared, but a new and equally great obstacle has been brought to light in the discovery that about one-third of the adult animals of the bovine species in Great Britain are already affected with tuberculosis. In support of this estimate it may be mentioned that during the past two years particulars relating to the testing of 4379 cattle have been communicated to the Editor by members of the veterinary profession practising in various parts of England and Scotland, and that out of that number 1389, or 31·7 per cent., reacted. As with few exceptions the animals tested were apparently healthy, there does not appear to be any ground for believing that if the whole of the breeding cattle in the country were tested the proportion of them found to be affected would be much less.

The discovery that about one-third of the breeding stock of the country are already affected with tuberculosis has made it impossible for any sane person to maintain that the Board of Agriculture ought to schedule tuberculosis under the Diseases of Animals' Act, and proceed to apply to it the measures which were successful in stamping out cattle plague and foot-and-mouth disease, but plans which are scarcely more rational are being urged upon the Government by some of their irresponsible advisers. An example of these crude ill-considered schemes is furnished in a paper by Mr Hunting which appears in a recent number of the *Journal of the Society of the Arts.*[1]

Mr Hunting recognises that if 20 per cent. of our adult cattle are infected, and we assume that all these animals must be slaughtered and partially paid for, "we enter on an undertaking that neither the owner of stock nor the tax-payer would approve." But he thinks "there is no necessity for such wholesale slaughter," and he proceeds to unfold the following plan for dealing with the disease.

[1] 27th January 1899.

"The majority of infected cattle are not infective to others—they are neither dangerous to man or other animals, and their slaughter would be a wicked waste. Only the visibly affected are dangerous, and their number does not exceed 40,000. This estimate would include every animal whose carcase is wholly unfit for human food and every cow whose milk is unfit for consumption.

The slaughter of these would be a loss to the owners, but it would be a public benefit, and it is expedient and just that the public should share the loss.

"I suggest that Local Authorities should pay as compensation £2 per head for all compulsorily slaughtered of a value not exceeding £8; and a sum equal to one-fourth the market value of all others seized—but no animal should be valued at over £24. Any salvage on carcases, minus the cost of removal and slaughter should be repaid to the owner.

"The payment of £2 as compensation for miserable animals that are a danger to man or to other stock may seem an illogical proceeding, but unless some such inducement is offered, many of them would be sold to the lowest class of butcher and find their way into human food. A payment of £2 per head would make it worth the while of the owner not to evade reporting to the authorities, and so the existence of disease would become known with greater expedition. Infected premises once recognised could be supervised in such a way as to assist the owner and protect the public.

"Compensation at the rate of £2 for all animals below the value of £8, and compensation at a higher rate on all over that value would probably reach a cost of £100,000 in the first year and a constantly decreasing sum every year afterwards until no disease existed. This is less than is now paid every year for the attempts to stamp out swine fever.

"For this payment what should we receive? A guarantee against human infection from animals, and a gradual but rapid suppression of disease among stock."

It is doubtful whether anyone aspiring to guide public opinion on the tuberculosis question has ever offered such ill-judged advice, or made a forecast which is so absolutely unjustified by knowledge and experience. Here we are told that only visibly tuberculous animals are dangerous, and that the slaughter of such animals, coupled with compensation to their owners, would lead to a rapid suppression of the disease. Furthermore, that the money required for compensation would probably be £100,000 during the first year, and less each succeeding year "until no disease existed." Now, if there is one well-ascertained point in connection with the subject of tuberculosis among cattle, it is that the disease cannot be stamped out by the simple and comparatively inexpensive method of slaughtering the animals that develop clinical symptoms of the disease. The idea to

the contrary is so obviously erroneous that an apology is almost necessary for taking the trouble to refute it.

Mr Hunting estimates that in the course of a year only 40,000, animals would require to be slaughtered on account of external indications of tuberculosis, and this, calculated on the basis of the most recent returns of the number of cattle in the United Kingdom, represents one animal for every 126 of the cattle population. Otherwise stated, Mr Hunting supposes that tuberculosis could be rapidly suppressed by the slaughter, on an average, of one animal annually in every third or fourth lot of cattle in the country, for the average number of animals in the possession of the same owner probably does not exceed forty. One is prompted to wonder why, if the matter is so simple as this, there is any call for the intervention of the State, at least so far as the interests of cattle-owners are concerned. Alas, that it should not be true that only every third or fourth farmer or cow-keeper in this country has in the course of a year as much as one clinically tuberculous animal.

One is tempted to think that some people spend so much of their time in the excogitation of what may be termed fancy methods of dealing with tuberculosis that they have no time to look into the recorded experience of those who have been practically applying themselves to the eradication of the disease. Hundreds of farmers and veterinary surgeons can testify to the practical impossibility of stamping out tuberculosis from among housed cattle by the slaughter of the visibly affected, and tuberculin has revealed to many an astonished owner that 20 or 30 per cent. of his animals are tuberculous although for years previously he had not lost a single animal from the disease, or had any reason to suspect its existence in his herd. Nor does this by any means state the full measure of the difficulty of stamping out tuberculosis. Centuries of the operations recommended by Mr Hunting would not suffice to stamp out tuberculosis, and even when resort is had to tuberculin, and every animal that reacts is killed or isolated, a clean bill of health is not always immediately obtainable. If anyone doubts this he may be referred to the often-cited experiments of Professor Bang in Denmark. Take, for example, the results of the attempts to eradicate the disease from the farm of Thurebylille. Here the whole herd was first tested in the spring of 1892, and all the animals that reacted—not merely the visibly diseased, as in Mr Hunting's plan—were promptly removed to a separate compartment. Twice annually after that, for five years, the tuberculin test was applied to what was called the "sound section," and on each occasion any animals that reacted were removed. What [was the result? The eighth, ninth, and tenth tests revealed respectively seven, seven, and six cases of tuberculosis; in other words, five years of this system had not sufficed to eradicate the disease. In face of this experience, how can anyone

with a reputation to lose pretend that tuberculosis could be stamped out by merely killing the visibly diseased animals?

To tell farmers that "only the visibly affected are dangerous" is to seek to propagate a most dangerous error. What requires to be impressed upon them is that the disease may be spread by an animal that appears to be perfectly healthy, and that therefore every animal that reacts to tuberculin must be considered dangerous, if the object is to obtain a clean bill of health.

But it may be said that if ten applications of the tuberculin test at half-yearly intervals to the apparently healthy animals, followed on each occasion by the removal of those that react, will not eradicate the disease, the ultimate advantage would not counterbalance the trouble and expense. It is probable, however, that the object in view may be obtained in much less than five years. As indicated elsewhere in this number, the tuberculin test is not infallible, and to guard against the possibilities of error it ought to be repeated at shorter intervals than six months, at least during the first year.

We do not agree with Mr Hunting in thinking that tuberculosis can be stamped out by the slaughter of the visibly diseased animals, but for another reason we consider that it is time that the law took cognisance of clinical symptoms of tuberculosis in cattle. In the forefront of such symptoms stands tuberculous disease of the udder. Since our last issue the Local Government Board have issued an order amending Article 15 of the Dairies, Cowsheds, and Milkshops Order of 1885, so as to provide that for the purposes of paragraphs (*a*) and (*b*) of that Article reference to disease shall include, in the case of a cow, such disease of the udder as shall be certified by a veterinary surgeon to be tubercular. This is no doubt a step in the right direction, but it is a very halting and inadequate step, since in the case of large towns which draw their milk supply mainly from outside sources it will leave the dangers arising from the sale of milk from tuberculous udders practically untouched. Tuberculous disease of the udder, or, better still, every disease of the udder of a milch cow, ought to be made notifiable, and the sale of milk from a diseased udder ought to be forbidden under a penalty. For reasons which we have explained in former articles, we are also of opinion that the sale of milk from an animal that is obviously tuberculous in any part of the body should be prohibited, and that notification of obvious signs of tuberculosis in a milch cow ought to be made compulsory. These measures are necessary as reasonable safeguards to the milk-consuming public, though their introduction cannot be urged on the ground that they would ever suffice to stamp out tuberculosis.

IS THE TUBERCULIN TEST INFALLIBLE?

"Is the tuberculin test infallible?" is one of the questions frequently asked by those who contemplate having their cattle tested. If the answer has to be monosyllabic it must be "No." No agent in human hands can be said to be infallible for any purpose, and although with the exercise of proper precautions the tuberculin test is marvellously reliable, it is not absolutely free from the chance of error, as the following considerations will show.

In the first place, tuberculin is not a substance of definite chemical composition and strength. It is obtained by cultivating tubercle bacilli in an artificial nutrient liquid, and its efficacy as a test depends upon certain substances of ill-defined chemical composition which are added to the liquid by the vital activity of the bacilli growing in it. As regards their mode of origin, these substances may be compared to the alcohol which is formed in a saccharine solution in which one of the yeasts is cultivated. Tuberculin would be termed weak or strong according to its richness in these substances, and it is a test for tuberculosis because a quantity of it which produces no appreciable effect on a non-tuberculous animal excites a short but sharp attack of fever, manifested mainly by a rise of temperature, in one that is tuberculous. But by using a sufficiently large quantity of tuberculin one may cause the temperature to rise in an animal that is free from tuberculosis, and by using too small a dose of tuberculin, or a tuberculin that from some error in its manufacture is too weak, one may fail to cause an elevation of temperature even in a tuberculous animal.

These facts alone may appear to carry with them serious chances of error, but as a matter of fact the risks of miscarriage which they involve are inconsiderable, provided the tuberculin is obtained from some reliable source, for there is already a large experience to guide those who manufacture it as to the proper dose, and there is fortunately a wide margin between the quantity that will excite a reaction in a tuberculous animal and the quantity that will cause the temperature to rise in a healthy one.

Another possibility of error arises from the fact that one has to measure the reaction to tuberculin by the elevation of the animal's temperature during the fifteen or eighteen hours after the injection of the substance, and that during this period the temperature may rise from some cause quite unconnected with the injection of tuberculin. This, again, may at first sight appear to provide serious risk of errors in diagnosis, but there is a circumstance which reduces it to very small proportions, viz., the fact that the reaction to tuberculin is measured not entirely by the *amount* of the elevation of temperature, but also by the *manner* in which the temperature ascends. The normal temperature of the ox is from 101° to 102° F., and when a

tuberculous animal of that species is tested with tuberculin its temperature begins to ascend a few hours afterwards, and *gradually* rises two, three, or four degrees, the maximum point being reached about the twelfth or fifteenth hour, after which it gradually falls again to the normal. Every rise which has this character must be taken as an indication that the animal is tuberculous, but sudden ascents of temperature followed by sudden falls to the normal must be set down to some accidental disturbance. The subjoined temperatures of two animals under the test will make this plain, the first showing the gradual ascent of a tuberculous animal, and the second an erratic rise determined by an accidental disturbance.

No.	*Time of Injection.*	*3 hours.*	*6 hours.*	*9 hours.*	*12 hours.*	*15 hours.*
1	101·8°	102·4°	103·4°	106·6°	105·8°	105·2°
2	102°	101·6°	102·2°	101·7°	101·7°	105·8°

It will thus be seen that one is able to recognise a good many accidental rises of temperature in animals under the test, and thereby to avoid the mistake of classing the animals in question as tuberculous, but it must be confessed that no amount of care can altogether evade the chances of error from this cause, and in certain circumstances these become very considerable. That is notably the case in animals that have been exposed before or during the test to excitement, such as is occasioned by transporting them to strange surroundings. On this account it has already been abundantly proved that the test is not to be relied upon when carried out on cattle in a market or slaughter-house. Wherever possible, cattle should always be tested in their own premises, and if they have experienced a change of quarters, the operation ought to be postponed until observation with the thermometer has shown that the temperature has become quite normal and steady. The complaints regarding uncertainty and errors in the application of the test to valuable animals sold for export are probably ascribable to neglect of this very necessary precaution.

The foregoing are possibilities of error in the direction of diagnosing tuberculosis in healthy animals, which is probably regarded by most people as the most objectionable mistake that can be made in carrying out the tuberculin test, but there is also a chance of error of the opposite kind, that is to say, of passing a tuberculous animal as healthy. Obviously this is a very unfortunate mistake to make, for it may lead to the introduction of the disease into a previously healthy herd, or it may nullify the sacrifice which an owner has made in disposing of all the animals that have reacted, with the object of eradicating the disease from his stock.

Mistakes of this kind probably sometimes arise from an oversight in performing the operation, part or the whole of the dose of tuberculin escaping between the hypodermic needle and the nozzle of the syringe, perhaps owing to some sudden movement of the animal at the moment of injection. Obviously, with the exercise of proper care, this ought to be a very rare accident. There is, however, one chance of error in this direction which is less easily avoided. It appears to be a very well established fact that an animal with actual tuberculous lesions in it will react to tuberculin, but between the moment of infection and the formation of actual lesions in the part to which the bacilli have gained access—the lungs for example—a certain time must elapse. Infection with the bacilli, whether by inhalation or ingestion, may be momentary, but it is not credible than an animal infected in the forenoon would react in the afternoon of the same day. The period of time that must elapse after infection before a reaction can be obtained is as yet undetermined, and possibly it varies according to the method of infection. The point is one of considerable importance, and the following experiments bear upon it. A steer which gave no reaction to tuberculin was infected by the injection of living virulent tubercle bacilli into one of its veins. Nine days afterwards, when tested with tuberculin, its temperature gradually rose from 101·4° until at the twelfth hour it had reached 105·3°, after which it gradually declined. A heifer which did not react was infected in the same manner, and when re-tested eight days afterwards it displayed a typical reaction, the temperature rising gradually to 105°. The test was repeated ten days later, and with a similar result.

It ought to be observed that in these cases a large number of bacilli were used to infect the animals, and it probably would not be safe to conclude that a reaction would be obtained as soon after natural infection by the inhalation of a few bacilli. To counteract this source of error it is advisable, when an attempt is being made to weed the disease out of a herd, to re-test those which have not reacted on the first occasion after an interval of not more than three months.

Lastly, among the possible errors that may be made in using tuberculin, there must be included the occasional failure to elicit a distinct reaction in animals which are emaciated and near the point of death from tuberculosis. This, however, cannot be considered a serious defect in the use of tuberculin, for such failures are only met with in animals that are worthless, and whose tuberculous condition is almost obvious.

It will be seen from the foregoing considerations that the tuberculin test is not one in which the possibility of error is absolutely excluded, but when the sources of error are known beforehand they may be guarded against, and a most trustworthy indication as to the existence or non-existence of tuberculous disease in the animal tested may be obtained.

THE NEW DISEASE OF DOGS.

THE translation of Professor Klett's article on the Stuttgart dog epizootic which appears at an earlier part of this number will, we feel sure, be read with much interest at the present time. As was first pointed out in a report made to the Council of the Royal Agricultural Society on the 1st of March of this year, the same disease has made its appearance in various towns in England, especially along the south coast. The identity of the symptoms and lesions leaves no room for doubt that it is the same disease as prevailed in some parts of Germany in the latter part of 1898. In this country also it was generally thought at the outset that the dogs were being maliciously poisoned, but such a view of the causation of the illness had to be abandoned when it became known that in several different towns the dogs were being attacked in precisely the same way.

That the disease is contagious can hardly be doubted, and, if it is so, it furnishes a most interesting instance of the sudden development of a previously unknown contagious malady. It is perfectly certain that it does not correspond with anything previously described in veterinary literature, and there are good reasons for believing that, whatever may have been its precise starting-point, it did not make its first appearance in Stuttgart. We believe that many dogs were seized with unexplainable symptoms of acute gastritis in Edinburgh in the summer of last year, and doubtless this was the same disease. If, as Professor Klett suggests, the German outbreaks were traceable to a Dog Show held in Stuttgart last year, it is not improbable that some British dog may have carried the disease there. Strange to say, the disease does not yet appear to have obtained a footing in London, but it may confidently be predicted that it will do so ere long.

Reviews.

The Penycuik Experiments. By J. C. Ewart, M.D., F.R.S., Regius Professor of Natural History, University of Edinburgh. With illustrations. London: Adam & Charles Black, 1899.

As is pretty well known in scientific circles, Professor Ewart has for a number of years been engaged in carrying out an extensive series of breeding experiments intended to throw light on the very vexed question of telegony, or the inheritance of qualities from the sire of previous offspring of the same mother. In the present volume the author has published together a series of articles which he contributed to the columns of the *Zoologist* and the *Veterinarian*, with an introductory chapter containing supplementary information regarding the results of his experiments up to the present time.

Professor Ewart's experiments are on the lines of the one unintentionally conducted by Lord Morton in the early part of this century, in which a mare that gave birth to a hybrid by a quagga, when subsequently mated with an Arabian stallion, bore foals with dark stripes, recalling those of the quagga. The animals used to produce the alleged "infection" of the mares have been zebras, and up to the present time Professor Ewart has obtained only one foal out of a mare that had previously given birth to a zebra hybrid. This foal, by an Arabian stallion out of a Highland pony mare, showed a number of faint but unmistakable stripes. In view of the occasional occurrence of stripes on foals out of mares that have never bred a hybrid, probably by a process of reversion to some striped ancestor of the modern horse, the opponents of telegony are not likely to admit that this experiment settles the question, but, repeating, as it appears to do, the results of Lord Morton's experiment, it undeniably strengthens the case for telegony.

All who have not had an opportunity to read the original articles will find this volume exceedingly interesting. It is enriched by a series of admirable illustrations showing the sires and dams used in the experiments, and their progeny.

Grundriss der klinischen Diagnostik der inneren Krankheiten der Hausthiere. Von Prof. Dr Bernard Malkmus, Dirigent des Pferdespitals an der Thierärztlichen Hochschule in Hannover. Jänecke, Hannover, 1899.

THIS is essentially a student's book. It extends to 183 pages, and contains a series of forty-three illustrations, most of which are exceptionally neat and clear. A work of the kind is calculated to be of considerable service both to student and teacher, and no fault can be found with the general plan of this one, though in many places it is open to the objection that the information given is decidedly too meagre, even for the purposes of a student. Moreover, we find in it a considerable number of what we take to be actual errors in teaching. Of these we may note a few.

In speaking of the diagnosis of quarter-evil, it is said that when the swelling is cut into a quantity of frothy liquid with an offensive smell (üebelreichende) escapes. This is incorrect if it refers to the usual character of the liquid before *post-mortem* decomposition has set in. In describing the method of staining for tubercle bacilli with carbol-fuchsin, it is directed that the cover-glass is to be warmed over the flame for two minutes. This is not a sufficiently long exposure unless the liquid is raised to a temperature approaching the boiling point. As a diagnostic agent mallein is said to be far less reliable than tuberculin, and this although it is said elsewhere that only about 90 per cent. of tuberculous animals show a positive reaction. These statements may be correct, but if they are, we fear the mallein in general use in Germany is of bad quality. It is directed that in taking the temperature of large animals the thermometer is to be left in the rectum for five minutes! Want of experience with German thermometers makes us hesitate to call this an error, but if it is correct, one wonders why some enterprising person there has not brought out an instrument that will save four minutes every time that the temperature of a horse or ox has to be taken.

CLINICAL ARTICLES.

A CASE OF "BILIOUS REMITTENT FEVER" IN THE DOG.

By HARRY GOODWIN, M.R.C.V.S., Antigua.

THE subject of the following report is a young pure bred "Dane," eighteen months old, and about 30 inches high.

In December, 1897, it was brought to this Island of "Antigua," and up to very recently the state of health was to all appearances all that could be desired.

On the 24th December last my attention was directed to its general appearance of ill-health. There was a listless phlegmatic look about it, the eyes were weak and sensitive to light, the vessels also were full and the lids very heavy. When disturbed it slouched instead of walked, the head was hung, and altogether the animal had a very depressed look.

About noon it took ill with a violent attack of ague, which lasted for over an hour. It was placed in the sun, well covered, and kept warm until an abatement in the symptoms took place.

The temperature commenced to rise rapidly, and two hours after it had gone up to 104° F. A fever mixture was given, but by 4 P.M. it was up to 106° F.

Phenacetin grs. v., followed in a few minutes with a fever mixture, was given every fourth hour.

25th December.—The temperature at 6 A.M. was still up to 105° F., and as it continued to keep between 105° F., and 106° F. all the morning I changed the treatment and gave antipyrin grs. v. and quinine grs. x. every fourth hour.

I had to stop the fever mixture, as the dog objected to its administration, and as it was a powerful brute no one could be got to hold it. It still continued to shun the light, as if that was very painful to the eyes.

In the afternoon there was a fall in the temperature to 103° F., but it was very unsteady. The bowels were slightly confined, so in the evening I gave a purgative pill.

26th December.—As the pill had not acted up to 8 A.M., I gave ol. morrh. ℥ii., and an hour after warm water enemata. There was some response about noon.

The animal could now scarcely be got to move; to even raise its head it was loathe, and when disturbed it would suddenly sink down again.

The urine was high coloured and passed in fairly large quantities.

The heart's action was at times very quick and irregular, the beats running to 130 if the dog was moved a few yards. I noticed that when made to walk it tottered for the first few steps, and indicated

pain in the region of the loins. I could find no reason for this, and the urine when examined showed no trace of albumen.

I examined the blood. It was pale; there were comparatively few sound discs, and one but rarely came across them in rouleaux. Any quantity of irregular shaped and crenated cells, which were either floating free or massed together, with a good number of disintegrated ones. I noticed in several of the crenated cells minute colourless bodies, sometimes one, at the most two, in one cell. They possessed a spasmodic kind of movement, darting across the face of the corpuscle suddenly from end to end. I also noticed them on the edge outside, giving to the cell a tremulous movement. I tried, but they did not stain with violet. Nourishment was taken fairly well during the day. In the afternoon it brightened up for a few hours, and took a little interest in things around.

27th December.—I felt it necessary to stop the quinine in consequence of its action on the heart. Not only was it very weak and irregular, but it was intermittent as well; hastening the dog's movements produced palpitation. I gave another dose of oil. The appetite was becoming capricious, but I succeeded in getting it to take something. There were two motions, both liquid, and slightly offensive. The urine was still high coloured, but passed in fair quantities several times during the day. I gave antifebrin grs. vi. every fourth hour. The temperature, from 105° F. at 6 A.M., fell to 103° F. at 12 noon.

28th December.—The same treatment was kept on with. There was a slight change for the better, the temperature falling in the early part of the day to 102° F. It took of itself some food. I had to give another dose of oil, as there was no action of the bowels from early the previous day.

29th December.—The temperature again rushed up, producing extreme prostration; by 6 A.M. it was up to 105° F. There was marked wasting of the tissues. The appetite was completely lost. Nourishment was administered, in the shape of bovril by the spoonful, on the tongue. The fæces were becoming more yellow and offensive. I was not satisfied with the working of the liver, and in the evening gave a pill (podoph. and calomel). I felt that, unless this organ could be got to act properly, the temperature would still continue to keep up, and ultimately kill the dog.

30th December.—I again made an examination of the blood. The white cells were in excess, in fact markedly so. There were a few more healthy red cells than on the 26th inst. Still to be seen large quantities of broken down and crenated cells collected together. The condition could not be much worse. It was very nauseated during the latter part of the night and early morning. In the afternoon there was a noticeable change for the better in the colour and character of the motions. They were very offensive and of a greenish tinge. The bile began to pass away in large quantities. The appetite was still suppressed, but the bovril was continued. The temperature gradually fell from 104° F. at 6 A.M. up to early the next morning, when it registered 102° F.

31st December.—Condition a little brighter. In other respects the same as the day before. As it was so much nauseated I gave nutrient enemata of bovril every third hour. It drank a little milk in

which I placed sod. phosph. grs. xx. The heart's action was not quite so quick, and it had lost its intermittency. The temperature to-day fell as low as 101$\frac{3}{5}$° F.

1st January 1899.—Condition same as previous day. All nourishment and medicine with the exception of the antifebrin was administered *per rectum*. There were frequent actions of the bowels, small quantities of almost pure bile passing away. I thought the dog looked a little brighter in the morning, but by 8 P.M. the temperature had again rushed up to over 105° F.

2nd January.—I ceased giving the antifebrin for the day. The animal was very low, at times in a complete state of collapse. The thirst seemed almost unquenchable. The temperature kept up all day from 104$\frac{3}{5}$° F. to 105$\frac{1}{5}$° F. The dog had, however, lost that sluggish somnolent look about the eyes, and the lids were relieved of the fulness so marked on the 24th December.

3rd January.—I am thankful to say from this date a change for the better took place. The temperature slowly but steadily fell to 103° F. It never again went above the 103°, and after the 5th remained between 101° F. and 102° F.

The phenacetin and quinine were continued for a few days, but only when the temperature showed an inclination to rise was it given.

By the 20th January the dog was quite lively and almost its old self again.

TUBERCULIN: CONSTANCY IN ACTION; ACQUIRED IMMUNITY.

By WILLIAM ROBB, F.R.C.V.S., Glasgow.

IT is not my intention to attempt to prove the infallibility of tuberculin, but rather to show that, once an animal reacts, it can be depended upon to do so at a short interval afterwards.

The cows I tested were chiefly Ayrshires in high condition, ready for slaughtering. The exceptions to these were two in calf, which the owner allowed to be tested with some hesitation, fearing abortion. Not having heard of this risk, I injected them both, with the result that one aborted about a week afterwards, while the other at the present moment is none the worse. The owner informed me that a farmer who tests his own cattle had a similar experience when he first used tuberculin, but that he never now uses it on a pregnant animal.

I should have liked to have injected these animals at shorter intervals, but could not find it convenient to do so. It was from France, I believe, we first got the idea that it was a trick in the cattle trade to dose animals with tuberculin, and it is now thought the correct thing by some veterinary surgeons in this country to speak as if they could prove that it was done here. I wonder how many of them could prove a case up to the hilt, or how many of them have tried for themselves to find out how many doses an animal will stand before it becomes immune, and how long this immunity lasts. Professor M'Fadyean, has, I believe, stated that an animal could be

depended upon to react to a second dose in a month's time, but from my small experiment it appears that it will react at a shorter interval.

FIRST INJECTION.

1899 Feb.	*Time.*	*No. 61*	*No. 62*	*No. 11*	*No. 31*	*No. 99*	*No. 56*	*No. 39*	*No. 65*	*No. 37*	*Bull.*
2nd	10 a.m.	102·0	101·1	101·7	101·6	101·5	102·0	101·0	102·3	101·8	102·0
4th	10 a.m.	101·1	101·3	102·2	101·1	101·4	101·4	102·1	102·0	102·0	101·2
"	6 p.m.	101·2	101·8	102·0	102·4	101·8	101·8	101·6	102·2	101·7	101·2
5th	6 a.m.	101·4	101·7	101·8	101·6	101·8	105·7	102·2	101·7	101·0	101·2
"	9 a.m.	101·6	103·1	101·7	105·0	102·4	105·0	103·5	102·0	101·6	101·7
"	12 noon	101·6	104·2	102·2	105·4	102·8	—	—	101·5	—	—
"	3 p.m.	100·8	103·0	102·2	104·0	101·4	101·8	101·4	101·7	101·0	100·6
"	6 p.m.	101·0	102·0	101·6	102·0	100·7	101·4	101·3	101·4	101·0	101·2
"	9 p.m.	100·8	101·0	—	101·5	—	101·0	100·0	—	—	—
6th	9 a.m.	—	100·0	101·0	103·0	100·5	100·3	—	—	—	—

The thermometer got broken at twelve o'clock, hence the blanks. The above were injected at 6 p.m., 4th February. Out of this lot I picked Nos. 62, 31, and 56 to be tried again, with the following result:—

SECOND INJECTION.

Feb. 1899.	*Time.*	*No. 62.*	*No. 31.*	*No. 56.*
9th	9 a.m.	100·0	100·0	100·2
"	6 p.m. (injected)	101·4	101·0	101·2
10th	6 a.m.	105·1	104·8	105·8
"	9 a.m.	105·0	102·8	106·3
"	12 noon	103·6	100·6	105·8
"	3 p.m.	102·2	101·2	105·5
"	6 p.m.	101·0	101·6	104·0
9th	9 p.m.	101·5	102·0	101·6
11th	6 a.m.	101·3	101·3	100·0

Again these animals reacted, as is shown by the above chart, Nos. 62 and 56 giving a higher, and 31 a lower reaction than on the first occasion. On the 22nd February 62 and 61 were killed, and apparently tuberculous glands from them were sent to Professor

M'Fadyean for examination. He replied that old obviously tuberculous lesions were present in each gland, but that microscopic examination had failed to reveal the presence of tubercle bacilli in either. On referring to the first chart it will be noticed that Cow 61 gave no reaction, but that Cow 62 is to be found in both charts reacting. The tubercle in gland of Cow 61 felt calcareous to the touch.

THIRD INJECTION.

Feb. 1899.	*Time.*	*No. 45.*	*No. 31.*	*No. 56.*	*No. 65.*	*No. 58.*	*No. 35.*	*No. 43.*
23rd	9 a.m.	—	101·6	101·2	101·6	101·8	101·3	101·9
"	5 p.m. (injected)	101·6	101·5	100·3	101·3	101·7	101·0	101·8
26th	6 a.m.	102·5	104·5	104·2	101·8	103·2	105·0	107·0
"	9 a.m.	102·9	103·8	105·6	101·8	104·6	106·0	106·8
"	11 a.m.	103·2	103·0	106·2	100·5	105·0	105·2	106·7
"	3 p.m.	103·8	101·4	104·1	102·0	103·2	103·4	105·0
"	6 p.m.	103·3	101·3	104·5	102·0	102·6	103·0	104·2
"	9 p.m.	102·3	101·4	103·2	102·0	102·8	103·2	102·8
27th	9 a.m.	102·2	100·8	100·5	102·0	100·2	102·3	101·4

No. 45 and 43 were in calf, and it was No. 45 which aborted. Nos. 31 and 56 were injected for the third time, and again gave a reaction. No. 65 was done for a second time, having been injected on the 4th February, and it gave a similar result on both occasions —no reaction.

On 10th March, No. 58, a reacting cow, was killed and no trace of disease found, and on the same date No. 31 was killed and found to be tuberculous in the bronchial glands and liver.

From these results it is certain that the injections would require to be at shorter intervals, to produce immunity. Further, whether tuberculin be wrong or right in its diagnosis, it would seem to be constant in its action.

SOME CASES OF MEDIAN NEURECTOMY.

By W. B. NELDER, F.R.C.V.S., Exeter.

THE following is a brief history of six cases in which median neurectomy was performed for the relief of lameness.

Case 1.—The property of an officer, was a bay harness gelding seven years old, which had been lame for six months owing to the presence of a splint under the knee. The animal had been fired and blistered several times, without permanent benefit.

Median neurectomy was performed on the 15th of July 1897, with the

satisfactory result that the horse went to work as soon as the wound healed, and has been working regularly ever since.

Case 2.—The property of a butcher, was a brown cob mare, aged, suffering from lameness on the off fore leg owing to a severe sprain of the suspensory ligament. The animal had been fired and blistered, three month's rest being allowed, without benefit.

Median neurectomy was performed on the 3rd of November 1897, the animal being put to work as soon as the wound healed, and working satisfactorily ever since.

Case 3.—The property of a coal merchant, was a brown cart gelding, aged, suffering from a severe sprain of the suspensory ligament, sidebone, and a very badly contracted foot. The animal had been lame for twelve months, during which time it had been twice fired and blistered, and had had four months out at grass without permanent benefit, as when tried at work lameness invariably returned within a few days.

Median neurectomy was performed on the 19th of October 1897, the patient being able to return to work as soon as the wound healed; it remained sound for three months, and then again fell lame. A blister was applied over the seat of operation, with the result that the lameness passed off and the animal worked satisfactorily for another six months. It was then sold to a farmer, in whose possession it is still working satisfactorily.

Case 4.—The property of a contractor, was a black cart mare, aged, suffering from lameness due to sprain of the perforatus and perforans tendons, ringbone, sidebone, and navicular disease. The animal had been very lame for twelve months, and had been fired and blistered several times without benefit; Smith's operation had also been performed on the foot.

This case appeared almost a hopeless one, but as it was the urgent desire of the owner that I should do all that was possible to save the animal, median and external plantar neurectomies were performed on the 1st of February 1898. The lameness disappeared, and the animal worked satisfactorily for six months; gelatinous degeneration of the foot then set in and the horse was destroyed.

Case 5.—The property of a veterinary surgeon, was a bay hunter, five years old, suffering from lameness due to a large splint under the knee. Blisters had been applied repeatedly without any benefit.

Median neurectomy was performed on the 15th of September 1898, after which the lameness disappeared completely; the animal has been hunted almost regularly all the season without showing any return of the symptoms.

Case 6.—The property of a horse dealer, was a bay mare, six years old, suffering from lameness due to a chronic sprain of the suspensory ligament. The previous history and length of time the lameness had existed were unknown.

Median neurectomy was performed on the 19th of November 1897, the animal becoming free from lameness and being eventually sold; since then I have been unable to trace it any further.

From my experience of these six cases I am very favourably impressed with the results of the operation, and certainly think that it is one which offers good prospects, when other known methods of treatment have failed, for returning an animal to a state of usefulness.

It will be seen that four of the cases have been in regular work for more than twelve months since the operation was performed, and that in each case the usual routine of firing and blistering had been tried and failed to give satisfactory results.

The case in which gelatinous degeneration took place had had external plantar neurectomy performed in addition to median, and it was probably the fact of the two operations being performed which accounted for the result.

RECURRENT ATTACK OF PURPURA HÆMORRHAGICA IN A HORSE.

By J. BAXTER, M.R.C.V.S., London.

THE subject, a bay gelding, was admitted to hospital on 3rd June 1898 off feed. On the evening of the 5th he was noticed to be suffering from acute pain, roaring, and to have a bloody discharge from the nose. On examination some petechial spots were found on the septum nasi. Anodyne medicine was given to allay pain. In a few hours after the acute attack sharply defined swellings made their appearance on the head and abdomen; the legs were also swollen, but not to the same extent. The abdomen and legs were bathed with hot water, and the head with dilute acetic acid. The after-treatment consisted in giving about 1½ drachms of iodine dissolved with iodide of potassium daily in the drinking water. In about a week after admission the skin on the anterior surface of the hind legs from the stifle to the coronet sloughed. On the twenty-fifth day after the attack the swellings had disappeared, the edges of the wounds had dried and showed signs of healing, and the general health of the animal was good. At the beginning of August recovery appeared complete, and the horse was put to do some work in the yard.

On 22nd October 1898 it was again admitted to hospital showing symptoms similar to those above described, and it died on the 5th November.

Autopsy.—Lungs gangrenous; petechial spots on heart and bowels; subcutaneous tissue filled with a dark red exudate.

Abstracts.

INFECTIVE SARCOMATA IN DOGS.[1]

DRS Smith and Washbourn report the results of some further experiments bearing on the etiology of certain sarcomatous growths occurring in the dog.

In a previous paper[2] they described a series of tumours on the genitals of dogs which spread from animal to animal as the result of coitus. These tumours, which were of various shapes and sizes, sometimes large enough to completely block up the vagina, originated in the mucous membrane of the vagina and penis. In some cases the walls of the vagina were deeply infiltrated, and the tumours frequently ulcerated. Death sometimes ensued, either from cachexia, or from kidney disease, the result of obstruction of the ureters, or from septic poisoning owing to sloughing of the growth. In one instance a secondary deposit was found in the inguinal lymphatic glands. The structure of the tumours was that of a round-celled sarcoma. They were enabled to successfully inoculate the tumours on the penis of one dog and into the subcutaneous tissue of two other dogs, the resulting tumours having the same structure as the original ones.

They also gave an account of certain experiments made by Wehr, Geissler, and Duplay and Cazin, and came to the conclusion that, although these authors gave a different interpretation of the microscopical structure, the tumours were identical with those described by them. Geissler looked upon the tumours as carcinomata, and he made successful inoculations into the subcutaneous tissue. In one instance he found, after inoculation, deposits in the internal organs; but as no microscopical examination of these deposits was made the connection between them and the original tumour could not be considered as proved. Wehr, who was successful in a number of inoculations, also looked upon the tumours as carcinomata. In one instance he found secondary deposits, which he stated to be carcinomatous, in the spleen and lymphatic glands. Duplay and Cazin, who made successful inoculations into the subcutaneous tissue, looked upon the tumours as inflammatory.

The tumours described by Drs Smith and Washbourn, whether identical or not with those of the above-mentioned authors, were certainly sarcomatous in structure. They sometimes infiltrated the deep tissues, and in one instance they obtained a secondary deposit in the lymphatic glands. They have since obtained secondary nodules in the internal organs, so that the tumours do not differ either in structure or in "malignancy," except, perhaps, in degree, from the sarcomata met with in the human subject.

In their previous paper the authors described the course taken by the tumours in the mucous membrane of the genitals when contracted during coitus. They also described a successful inoculation performed into the mucous membrane of the penis of a dog. The subsequent history of this case was as follows:—

The tumour reached its maximum of growth twelve months after inoculation. It then formed a lobulated mass half an inch in diameter; a small portion which was snipped off was found to have the same structure as the

[1] "Brit. Med. Journal," 17th Dec. 1898.
[2] "Journal of Comparative Pathology and Therapeutics," Vol. XI., p. 41.

original tumour from which it was derived; four months later it began to diminish in size, and had completely disappeared in another two months.

They draw especial attention to this case, because it is the only instance in which they have observed the tumours disappear spontaneously when situated in the mucous membrane.

They have since inoculated successfully the vagina of a bitch.

A young terrier bitch was inoculated by rubbing a portion of an infiltrating vaginal growth from another bitch over the seared surface of the mucous membrane of the vagina. At the end of two months the animal was killed. At the *post-mortem* examination, two smooth tongue-shaped tumours, the one half an inch in diameter, and the other rather smaller, were found near the urethral orifice. They were microscopically of the same structure as the other tumours.

They have not considered it necessary to make further inoculations of the mucous membrane, but they have made a series of inoculations into the subcutaneous tissue.

The method adopted for inoculation was the following: The animal is placed under an anæsthetic, and the skin on each side of the abdomen is carefully shaved and cleansed. A small incision is made with a pair of scissors, which are then pushed under the skin so as to make a track in the subcutaneous tissue. One or two small fragments of growth are then introduced by means of forceps along the track for an inch to an inch and a half from the skin incision, which is subsequently closed with stitches and sealed with collodion and iodoform. The whole operation is performed with careful aseptic precautions. The fragments of tumour inoculated were always used immediately after removal.

General Result of Inoculations.—Including two animals mentioned in the previous paper, they have made inoculations into the subcutaneous tissue of seventeen dogs. In four dogs the inoculation was unsuccessful, while in the remaining thirteen definite tumours developed. Of the seventeen dogs, six were inoculated with growths from the genitals, and in all a successful result was obtained. These primary growths were obtained from three separate bitches, two with a malignant type, and the third with a simple type of growth. The tumours resulting from inoculation were similar in all three series. The remaining eleven dogs were inoculated with growths from the subcutaneous tissue obtained by artificial inoculation. Definite tumours developed in seven of these animals, whilst in four of them the inoculations were unsuccessful.

They have used as a rule wire-haired terriers, but they have not made sufficient experiments to state what kind of dogs are most susceptible. Most of the dogs were quite young; but they have successfully inoculated an old dog. Some dogs appear to be naturally refractory, and resist repeated inoculations.

A young white terrier was unsuccessfully inoculated on three occasions, the intervals between the first and the second and between the second and the third inoculations being six and seven weeks respectively. Control animals were successfully inoculated on each occasion at the same time and from the same source.

An old wire-haired terrier was unsuccessfully inoculated on two occasions at an interval of seven weeks. Control animals were successfully inoculated on both occasions at the same time and from the same source.

The tumours are capable of being transmitted at any time during active growth, and they do not apparently exhibit any marked difference as regards virulence during this period. The earliest successful inoculation was made from a tumour twenty-one days old; the latest from one three months old. As soon, however, as the stage of subsidence is reached, and the growth becomes flabby and begins to dwindle, transmission is no longer possible.

Two of the unsuccessful inoculations can thus be accounted for, and the other two by the fact that the dogs were, as was subsequently proved, naturally immune.

Serial Inoculation.—The following experiments were made with the object of ascertaining whether the tumours could be transmitted through a series of dogs by subcutaneous inoculation, and, if so, whether an increase of virulence would result.

The material for inoculation was taken from the vagina of a bitch with a growth of an infiltrating malignant type.

Dog A, a young, fawn-coloured bitch, was inoculated in both flanks with fragments of the tumour from the bitch. At the end of eleven days there was a slight discharge of pus on the right side, but nothing to be felt on the left. At the end of twenty-one days a lobulated growth, the size of a filbert, could be felt on the left side. This was excised, and used for inoculating B.

Dog B, a wire-haired puppy bitch, was inoculated in the left flank from A. At the end of ten days there was a minute nodule, which at the end of twenty-five days had disappeared. At the end of thirty-eight days there was no sign of growth. At the end of two months a distinct tumour three-quarters of an inch in diameter was found (the animal had not been examined since last note). At the end of three months there was a large lobulated growth the size of a hen's egg, with well-defined margin slightly attached to the skin, but otherwise freely movable. A portion was removed for inoculating C. At the end of three and a half months the tumour was 2½ by 1¾ inches, soft and elastic in places, with the overlying skin adherent, red, shiny, and thinned out. At the end of four months the skin had broken down, causing a deep ulcer extending into the growth with thickened edges. At the end of five months the ulcer had healed, and there was a rosette-shaped mass 1¼ inches in diameter, with depressed scar in the centre, and with the overlying skin thin, red, and adherent. At the end of six months the mass had again increased to 2 inches in diameter; it was flabby, and the skin over it had ulcerated in two places. From this time it began to diminish. At the end of seven months there was a small flabby mass of cicatricial tissue; and at the end of eight months the growth had completely disappeared. At the end of eight and a half months there was some recurrence, a growth the size of a walnut being present. At the end of nine months the growth was flabby and dwindling. At the end of nine and a half months the animal was killed, and the growth was proved to be represented by a little fibrous tissue.

Dog C, a small, thin, wire-haired puppy, was inoculated in both flanks from B. At the end of a month several small nodules the size of peas were present on both sides. At the end of six weeks the nodules had fused together so as to form lobulated masses ¾ by 1 inch on both sides. At the end of two months the growth on the right side was 1¼ inch in diameter, and that on left side 1½ inch in diameter. Dogs D and E were inoculated from portions of the growth on the right side. At the end of three months the growth on the right side was 2½ by 2 inches, and that on the left side 3½ by 2½ inches; the skin over both was ulcerated, but the growths were firm, and apparently growing at the periphery. At the end of four months there was deep ulceration on both sides, the edges of the ulcers being firm and indurated. At the end of five months the two growths had nearly united, forming an ulcerated mass 3¼ by 2¾ inches. At the end of six months the animal died, the growths, which had for a time diminished in size, having again increased. There was, at the *post-mortem* examination, on the right side of the abdomen a mass about 4 inches long extending up to the thorax, and ulcerated at its lower part. A similar mass, but not quite so large, was present on the left side. In the liver a large number of small roundish nodules were found, varying in size from that of a millet seed to half an inch in diameter, the majority being one quarter

to one-third of an inch. As many as thirty were counted, but more were present. They were white and soft, and resembled the original tumours in consistence and appearance. None of them were breaking down. Those which were situated on the surface of the liver were umbilicated. In the spleen there were four nodules from one quarter to one-third of an inch in diameter similar to those in the liver. The lungs and the other abdominal viscera were free. Sections of the nodules in the liver and spleen, examined microscopically, showed a structure similar to that of the original tumours.

Dog E, a small, wire-haired puppy, was inoculated in both flanks from C at the same time as dog D. At the end of seven days a nodule about the size of a pea was felt on both sides. At the end of a month there was a nodule about three-quarters of an inch in diameter on the right side, and a bilobed nodule $\frac{3}{4}$ by 1 inch on the left side. At the end of two months there were lobulated growths on both sides, that on the left side being 3 by $1\frac{3}{4}$ inches, and that on the right side $2\frac{1}{2}$ by $1\frac{1}{2}$ inches. At the end of three months there was a mass 4 by 2 inches on the right side, and a mass 3 by 2 inches on the left side. A fragment was removed, and dog F inoculated. A fortnight later both growths had considerably diminished, and were very flabby. At the end of four months the growth on the right side had completely disappeared, and a few days later that on the left.

Dog F, a long-haired brown puppy bitch, was inoculated in both flanks from E. During the first few days after inoculation a small nodule was felt, but this quickly disappeared, and no tumour developed. The tumour on dog E at the time of inoculation was flabby, and just beginning to dwindle.

Dog D, a bull terrier puppy bitch, was inoculated in both flanks from C at the same time as E. At the end of a fortnight there was nothing to be felt on either side. At the end of a month several nodules, forming a mass about $\frac{3}{4}$ by 1 inch, were felt on both sides. At the end of six weeks there was a growth on the right side 1 by 1 inch, that on the left side being $1\frac{1}{4}$ by 1 inch. A fragment was removed from the left side to inoculate G and H. At the end of two months there was a globular mass on the right side $1\frac{3}{4}$ by $1\frac{1}{3}$ inch, with the skin over it red and shiny; on the left side growth $1\frac{1}{2}$ by $1\frac{1}{2}$ inch. At the end of three months both growths were adherent to the skin, that on the right side being 2 by 2 inches, and that on left side $1\frac{1}{2}$ by $1\frac{1}{2}$ inch. At the end of four months the growth on the right side had completely disappeared, and that on the left side was the size of a walnut, soft and puckered. At the end of five months nothing was to be felt on either side.

Dog H, an old wire-haired terrier bitch, was inoculated in both flanks from D at the same time as G. No tumour developed on either side. This dog was subsequently shown to be naturally immune.

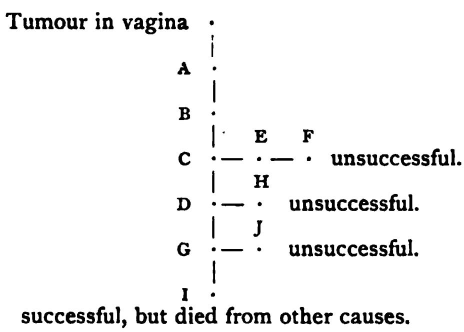
Dog G, a young terrier bitch, was inoculated in both flanks from D at the same time as H. Some ulceration occurred on the right side, which healed in ten days, leaving indurated tissue behind; at this date there was a distinct nodule on the left side one-third of an inch in diameter. At the end of three weeks there was nothing to be felt on the right side, on the left side a nodule half an inch in diameter. At the end of six weeks the nodule on left side was $\frac{3}{4}$ by $\frac{3}{4}$ inch. At the end of seven weeks a fragment of growth was removed, and dog I inoculated. The wound healed in a few days. At the end of nine weeks the growth was firm and smooth, $1\frac{1}{2}$ by $1\frac{1}{2}$ inch. At the end of eleven weeks the growth was 2 inches in diameter, it was breaking down, and the skin over it had given way. At the end of three and a half months a fragment was removed from the edge and J inoculated. Two months later the growth had completely disappeared.

Dog I, a young wire-haired terrier, was inoculated in both flanks from G. At the end of three weeks nothing was to be felt on either side. At the end of a month a few minute nodules were felt on both sides. At the end of five

weeks there was a string of small nodules $1\frac{1}{2}$ by $\frac{1}{2}$ inch on the right side, and on the left side a similar mass $1\frac{3}{4}$ by 1 inch. The animal died at the end of forty-eight days from an inflammatory swelling on the face having no connection with the inoculation.

Dog J, a young short-haired terrier, was inoculated on both flanks from G. Some inflammatory swelling occurred, and at the end of a fortnight there was a small nodule the size of a pea on each side. These completely disappeared in the course of a week, and no tumour developed. It will be observed that this dog was inoculated with a fragment of a tumour which was breaking down.

The following table represents the series of subcutaneous inoculations:—



This series shows quite clearly that the tumours can be transmitted by subcutaneous inoculations through a number of dogs. The series came to an end owing to the death of dog I from cellulitis of the face, in no way connected with the inoculation. The unsuccessful inoculations were F, H, and J. Of these, F was inoculated from a tumour which was flabby and beginning to dwindle, J from a tumour which was breaking down, and H was one of the two dogs we have previously mentioned as naturally immune.

There is no evidence of an increase in virulence by passage through the series, but the number is not sufficient to draw conclusions from.

Course taken by the Tumours after Subcutaneous Inoculation.—For the first few days after inoculation a swelling can be felt, due partly to the fragments of tumour introduced and partly to inflammatory exudation. In some cases this swelling completely subsides, so that nothing can be felt until the appearance of a small nodule indicates that the inoculation has been successful. In other cases the swelling persists, and it is difficult to decide whether the inoculation has been successful until a definite increase in the size of the swelling has taken place. The usual time at which there is distinct evidence of the first appearance of the growth after inoculation is about three weeks, but it varies between twelve days and a month. The tumours from some sources seem to be more active than from others. Thus in the first series of inoculations made from a pedunculated growth in the vagina the secondary growths were noted as being half-an-inch to $1\frac{1}{2}$ inch in diameter sixteen days after inoculation. In a recent series made from a vaginal growth of very malignant type a definite increase in the size of the swelling following inoculation was observed twelve days after inoculation. In a third series made from an infiltrating but very slow growing vaginal growth the time was invariably longer, varying from three to four weeks.

The small firm nodules which first appear gradually increase in size, and form rounded lobulated masses. At the commencement they are freely movable beneath the skin, but at a later period the latter becomes thinned out, of a bluish-red colour, and firmly adherent to the growths. In consist-

ence the growths are firm and elastic, and as a rule they remain fairly movable on the deep parts. The size ultimately attained varies; it usually reaches from $1\frac{1}{2}$ to 3 inches in diameter. The maximum growth is attained in about three months. A curious regularity obtains in this respect. Of seven animals in one series in which the growth was allowed to reach its full development, in six the maximum growth was reached in, as nearly as possible, three months, while in the remaining one the maximum was reached in two and a half months. Having reached this stage retrograde changes are not long in appearing. The growth becomes soft and flabby, and slowly dwindles until nothing is left to indicate its former presence. This on an average takes three months, the tumour running its entire course in about six months. In one case disappearance of the tumour occurred within a fortnight after attaining its maximum growth, while in another it took as long as five months. In nearly half the cases the subsidence of the tumour was accompanied by ulceration. The thinned-out, reddened skin gives way over the growth, which has previously undergone softening, and there results a deep ulcer, from which a thin grumous discharge flows.

Even when these retrograde changes are occurring, fresh growth occasionally takes place at the periphery of the tumour. This was marked in Dog C where the growth, which had ulcerated, and had considerably diminished in size, commenced to grow again.

In one instance—Dog B—recurrence took place even after the growth had apparently disappeared. A fortnight after the authors had noted the complete disappearance of the growth, a recurrence was observed at the site of the old tumour. A fortnight later it had reached the size of a walnut; it then became flabby, and seventeen days later when the dog was killed, it was represented by a small fibrous mass.

In one case—Dog C—the growth persisted till the death of the dog, which took place apparently as the direct result of the tumour and its secondary deposits in the viscera. The animal was thin and weakly before the inoculation, and to this is probably to be attributed its want of resistance.

Microscopical examination of the tumours in the subcutaneous tissue produced by inoculation and of the secondary deposits in the organs showed that they had a structure identical with that of the primary growth on the genitals. They were composed of small round cells, sometimes loosely packed, preserving their round form, sometimes more closely packed, assuming a polyhedral shape. There was a delicate stroma enclosing the cells in spaces of variable size. Numerous thin-walled blood vessels were to be seen not only in the supporting framework, but also between the cells. The growths presented the characteristics of a round-celled sarcoma. Nothing of an inflammatory character was to be made out in the actively-growing tumours, and it was only when ulcerated or diminishing in size that an infiltration of the growth with inflammatory products was to be seen.

Acquired Immunity.—An animal which has once recovered is immune, and the authors have never been successful with subsequent inoculations.

1. An old black and tan terrier was successfully inoculated in the flank. The resulting tumour, which in six weeks formed a lobulated mass $1\frac{3}{4}$ by $1\frac{1}{4}$ in., completely disappeared in ten weeks. A month after the disappearance of the tumour the dog was unsuccessfully inoculated in both flanks from a vaginal tumour. A second dog was successfully inoculated from the same tumour at the same time. Seven weeks later it was again unsuccessfully inoculated from a vaginal tumour. Another dog was successfully inoculated from the same tumour at the same time.

2. A young fawn bitch was successfully inoculated in one flank. The resulting tumour reached the size of a filbert. It was removed, and was used successfully to inoculate another dog. A month after the disappearance of

the tumour the dog was unsuccessfully inoculated from a vaginal growth. Another dog was successfully inoculated from the same growth at the same time.

3. A white wire-haired puppy was successfully inoculated in both flanks. The resulting tumours, which reached the size of 1¾ in. in diameter, had completely disappeared in three months. The dog was then unsuccessfully inoculated from a growth in the subcutaneous tissue. Two other dogs were successfully inoculated from the same growth at the same time. Five weeks later the dog was again unsuccessfully inoculated from a subcutaneous tumour. Another dog was successfully inoculated from the same tumour at the same time.

4. A black and white terrier puppy was successfully inoculated from a vaginal growth in both flanks. The resulting tumours reached the size of about 2 inches in diameter and then ulcerated, and completely disappeared in six months. The dog was then unsuccessfully inoculated from a subcutaneous tumour. Another dog was successfully inoculated from the same tumour at the same time.

Conclusions.—1. The tumours in question are infective round-celled sarcomata occurring in dogs.

2. The tumours can be transplanted from the genitals, where they naturally occur, to the subcutaneous tissue of other dogs.

3. The tumours can be transplanted from subcutaneous tissue to subcutaneous tissue through a series of dogs.

4. The tumours after reaching the maximum of growth may disappear spontaneously with or without ulceration.

5. The tumours may continue to increase, and may cause death by secondary deposits forming in the viscera.

6. If the tumour should disappear the animal is then immune to subsequent inoculation.

REPORT OF THE COMMISSION FOR THE INVESTIGATION OF FOOT-AND-MOUTH DISEASE AT THE INSTITUTE FOR INFECTIOUS DISEASES, BERLIN.

By Geh. Med-Rath Prof. Dr LOEFFLER and Prof. Dr FROSCH.[1]

I.

BERLIN, *17th April* 1897.

(1) *Investigations Regarding the Etiology of the Disease.*—Thanks to the telegraphic reports regarding fresh outbreaks of foot-and-mouth disease which reached the Institute for Infectious Diseases, a large quantity of fresh material was available for examination. For this purpose places were selected within easy distance, so that is was possible to return the same day and examine the materials obtained while they were still quite fresh. The best material for investigation appeared to be the contents of quite recently developed vesicles in the mouth and on the udder of affected animals, because from such places the contents of the vesicles could be obtained free from accidental impurities, whereas it is very difficult to obtain matter in an uncontaminated condition from the feet, even when the most careful disinfection of the skin has been carried out.

Since experience had shown that in vesicles which are several days old bacteria may have propagated into their interior, care was taken to use only such vesicles as were quite recent. Unfortunately, these are rarely to be

[1] "Berliner Thierärztlichen Wochenschrift."

found, and even in outbreaks affecting large numbers of animals only one or two animals furnished such vesicles. In collecting the lymph the surface of the vesicles was first treated with absolute alcohol, and the lymph was then taken in sterilised glass capillary tubes thrust into the interior of the vesicle. In this way the contents of vesicles from twelve animals were obtained and subsequently examined. The examination included a search by the aid of bacteriological methods (hanging-drop, staining, cultivation). The culture media used were ordinary bouillon, both acid and alkaline, peptone bouillon, grape-sugar bouillon, liquid and solid blood serum, milk, nutrient agar, and gelatine, and the cultures were made with exposure to air or in an atmosphere of hydrogen, sulphuretted hydrogen, or carbonic acid.

The results of all these different methods of investigation were absolutely identical. No bacteria of any sort could be detected by the examination of hanging-drop cultures. In the great majority of cases culture media inoculated from the contents of the vesicles and kept under observation for several weeks remained absolutely free from any bacterial growth, and in those instances in which bacteria did develop it was perfectly obvious that the colonies had resulted from bacteria which had accidentally gained access to the culture vessels. That in spite of this negative result of bacteriological examination the lymph did actually contain the cause of foot-and-mouth disease was evident from the fact that calves and yearlings which were inoculated with the same material on the mucous membrane of the upper or under lip always developed the disease in a typical way after two or three days; and that the vesicles thus produced were not the result of any poisonous substances in the materials employed was proved by the fact that the disease thus set up spread to healthy animals kept in the same place with the experimental ones. From the result of these experiments it may with certainty be concluded that any bacterium which grows on any of the nutrient media in common use is not the cause of foot-and-mouth disease. Nevertheless the Commission considered it necessary to submit to examination a particular species of bacterium which had been found by Drs Siegel and Bussenius in alleged fatal cases of foot-and-mouth disease in the human subject, and also in cases of the same disease in animals, and this appeared to be the more necessary because these authors had alleged that they had been able to produce typical foot-and-mouth disease in calves and pigs with pure culture of their bacillus.

The Commission placed themselves in communication with these gentlemen, and obtained from them several pure cultures of the bacillus in question. It proved to be an actively motile bacillus, and grew luxuriantly in ordinary bouillon, grape-sugar bouillon, peptone bouillon, nutrient agar, and gelatine. Isolated colonies of the bacillus, when growing in the last-mentioned substances, are easily distinguishable owing to a peculiar marking which they present when slightly magnified. The bacillus itself frequently shows a certain tinctorial peculiarity, inasmuch as it stains more deeply at the ends than in the middle, or in other cases its central parts appear stained, whereas the intermediate parts show little or no colour. This method of staining depends upon the action of certain salts in the nutrient media employed, and it is therefore not always observable. Inasmuch as, according to the views of its discoverers, the bacillus is mainly found in the blood of recently attacked animals, although frequently only in very small numbers, special attention was always directed to examination of the blood. In five cases blood was taken from the jugular vein of recently attacked animals by means of a sterile trocar, and collected in sterile Erlenmeyer flasks; blood was also taken from the heart of two calves which had been killed at the height of the disease immediately after development of vesicles. Large quantities of the blood were used to inoculate bouillon, nutrient agar, and nutrient bouillon, the flasks being then placed in the incubator. In the great majority of cases the flasks thus

inoculated remained permanently sterile, but in a few of them micrococci, and in some others bacilli, developed. Most of the latter belonged to the group of pseudo-diphtheria bacilli, and had not the most remote resemblance to the bacillus of Siegel and Bussenius. They were obviously accidental impurities which had been obtained from the skin of the animals in taking the blood.

These negative results of experiment are in contradiction with the positive assertion of the authors named, that they had succeeded in producing the typical disease with their bacillus; nevertheless the Commission considered it advisable to afford them an opportunity to demonstrate the experimental production of the disease with the bacillus. The Commission were mindful of the fact that experiments of this sort might easily lead to a false conclusion, since the disease might be conveyed to the inoculated animals by the attendants, or even by the members of the Commission themselves, who were almost daily brought into contact with animals suffering from foot-and-mouth disease. It was therefore decided to carry out the experiments in a stable, and on animals which had been purchased from a district known to be free from foot-and-mouth disease, as well as on two sucking calves bought at the slaughter-house, Berlin. The animals were attended to by a servant of the Institute who was forbidden to have any intercourse with the other servants.

Inasmuch as it was possible that the bacillus of Seigel and Bussenius might have lost some of its virulence from long cultivation in nutrient gelatine, at the desire of these two gentlemen an attempt was made to infect the two sucking calves by pouring about 50 ccm. of a two-days-old bouillon culture of the bacillus into the mouth of each animal. At the same time, however, two yearlings were inoculated by scarification on the upper and lower lips in the same manner as one proceeds in infecting animals with foot-and-mouth disease lymph. In the case of the yearlings the material employed was a fresh culture of agar, and a large quantity of the culture was also rubbed on the mouth of these two animals, so that an infection of the intestine was also made possible.

On the following day the sucking calves were already ill, with high fever and symptoms of intestinal affection. One of them was killed while very ill on the third day, and the other died in the course of the following night. In both of these animals the bacilli were found in the blood and spleen, and especially in the much swollen mesenteric glands, as well as in contents of the intestines. Their presence in these positions was demonstrable by microscopic and cultural examination. Neither of the animals had lesions in the mouth or on the feet, such as are characteristic of the disease in question. On the contrary, they were affected with a severe enteritis.

With a two-days-old bouillon culture started from the heart blood of the above calf in which death resulted naturally, three new animals were infected at the instigation of Drs Seigel and Bussenius, in order to induce a less acute form of the disease, and thus to give time for the production of the characteristic lesions. One of these was a sucking calf and it received 2 ccm. into the mouth. The second animal was a three-months-old calf, and the third a yearling, and each of these received 5 ccm. into the mouth. On the following day the sucking calf was already the subject of high fever and profuse diarrhœa, and it died on the fourth day. The *post-mortem* examination showed practically the same conditions as in the above-mentioned calves.

The three-months-old calf became ill on the second day, being also attacked with high fever and profuse diarrhœa. Subsequently, however, it recovered, though its temperature remained for a long time over 41° C. Both the inoculated yearlings, and also the one infected by feeding, sickened on the fourth day, with rather high fever and profuse diarrhœa. The fever lasted from two to four days, and as it declined the diarrhœa also abated. During

fourteen days' observation none of the animals showed any symptoms of foot-and-mouth disease.

From these experiments it follows that the bacillus of Seigel and Bussenius, although an interesting and remarkable pathogenic organism, capable of setting up severe intestinal disease, is not the cause of foot-and-mouth disease.

From the results of the investigations above described it may also be concluded that the bacteria found by other observers—Nosotti, Klein, Schotteluis, Kurth, Nissen, Starcovici, Furtuna, and Stutzer, in cases of foot-and-mouth disease, did not represent the causal agent of the infection.

There still remained for investigation the claims of certain observers who have described, not bacteria, but small protoplasmic structures with distinct amœboid movements, as the cause of the disease. Claims of this sort have been put forward by Piana, Fiorenti, Behla, and Jürgens.

Numerous preparations made from lymph were searched for such structures. In the lymph there were constantly found the following morphological elements:—

1. Colourless lymph cells.
2. Granular cells.
3. Red blood corpuscles.
4. Delicate, pale, finely granular, round discs, without distinct nucleus, and varying in size, but on an average from a quarter to half the size of a red blood corpuscle; not seldom such structures contain one, two, or even three glancing granules.
5. Protoplasmic structures of irregular shape, sometimes more or less strongly refractile, devoid of a nucleus, and showing continual oscillating movements. These structures perhaps correspond with the things which have been put forward by the before-mentioned observers as the cause of foot-and-mouth disease, but the members of the Commission have not been able to convince themselves that they possess the power of independent amœboid movement.
6. In every case there were found numerous markedly refractile granules of various sizes, from the most minute points up to the size of the discs described under number 4.

The structures described under 4 and 5 could be stained by different methods, and by double staining it could be made out that those described under number 4 are made up of two substances with different tinctorial properties. The appearance of these recalled in a remarkable way that of embryonic erythrocytes.

The members of the Commission were unable to confirm the view of the above-mentioned observers that the protoplasmic structures in question are found only in the contents of the vesicles of foot-and-mouth disease. These structures therefore cannot be regarded as specific for the disease in question. The multiplication of them in or on nutrient media inoculated with the contents of vesicles could never be made out. Even on culture media specially prepared for the purpose they could not be cultivated.

(2.) Apart from the discovery of the causal agent of foot-and-mouth disease, which the Commission had hitherto placed in the first line of their investigations, their enquiries were extended in a number of other directions, as follows:—

1. The transmission of the disease to the various species of animals.
2. The method of infection.
3. The material of infection.
4. The resistance of the virus.
5. The destruction of the causal agent.
6. The development of immunity after recovery from the disease.
7. The possibility of discovering a method of protective inoculation.

Transmission of the Disease to Different Species of Animals.—The only animals that we have been able to infect experimentally with certainty are cattle (2) or calves (13). Out of twenty-two attempts to infect pigs only eight were successful. There was no success in eight attempts with sheep, and only one out of the same number with goats. Attempts were also made to infect 30 rabbits, 14 guinea-pigs, 3 dogs, 4 cats, 5 rats, 10 house mice, 10 field mice, 6 hens, and 6 pigeons, but the attempts failed, whether they took the form of inoculation into the mucous membrane of the mouth or into the limbs, intraperitoneal injection, or feeding with fresh materials.

Mode of Infection.—According to experience, in adult cattle and calves infection follows when materials moistened with fresh slaver from diseased animals, such as towels, sponges, or wisps of straw, are used to rub the mouth; but even in this way infection does not always follow with certainty. For example, in one instance only nine out of seventeen animals which it was sought to infect in this way on each of three successive days in the same building contracted the disease. The disease was experimentally transmitted to two yearlings and 13 calves by rubbing a drop of lymph on the slightly scarified mucous membrane of the upper and lower lips. The vesicles developed not only at the places scarified but also in their neighbourhood, on the palate and tongue. In the case of the yearlings vesicles developed on the feet, but in the great majority of cases the disease did not attack the feet in the calves. It was observed that the vesicles formed on the feet one or two days after the disease had shown itself in the mouth. On the second or third day after experimental infection the temperature rose 1° or 1½°, and in the course of the next three days it fell to the normal. The formation of vesicles set in from the first to the third day, generally on the second day, after inoculation. In the case of ten oxen inoculated in the skin of the back or on the posterior aspect of the thigh, no local lesion was produced, and up to the fifth day after inoculation none of the animals appeared to have contracted the disease. Unfortunately this experiment was vitiated by the fact that three days after the inoculation in the skin the owner had also attempted to infect the animals, so as to get rid of the disease as quickly as possible. After that the animals developed the symptoms of foot-and-mouth disease, but it was impossible to determine whether this was the result of the first or the second attempt to infect them.

In the case of a calf one-tenth ccm. of lymph was injected under the skin of the shoulder, and on the second day afterwards the typical lesions had developed in the mouth. It is possible that in this case the injection had been made into a blood vessel, for it was observed that a drop of blood exuded when the needle of the syringe was withdrawn. In the case of another calf 10 ccm. of blood serum taken from an animal at the height of the disease, and mixed with a drop of lymph from a vesicle, was injected under the skin, but the calf did not develop any symptoms of the disease during the next fourteen days. The question whether infection can take place from the subcutaneous tissue or from the blood stream, therefore, requires further experiments for its elucidation. Further investigation is also necessary to settle the practically important question whether an animal can be infected through the unwounded skin of the claws.

In three of the pigs experimentally infected the disease was transmitted by feeding, and in the others by inoculation between the claws. Cutaneous inoculation on the back and at the snout had negative results.

Infective Material.—The contents of freshly developed vesicles have been found to be the most certainly effective material for infection. Serum of blood taken from the jugular vein of diseased animals during the period of vesicle formation, and subcutaneously injected in quantities of from 10 to 14 ccm.,

did not produce the disease in three calves. Experiments regarding the infectivity of the urine and fæces of diseased animals have not yet been carried out.

Period during which the Virus remains Active.—The contents of capillary tubes kept in an ice chest sufficed to infect a calf, and in another case a pig, after twelve days.

Acquired Immunity.—Some veterinary surgeons are of opinion that one attack of the disease confers an immunity which lasts for one, two, or even three years, though it is said that this immunity is not observed in all animals. Three calves which, twelve, seventeen, and twenty-two days respectively after the first inoculation, were re-inoculated with material known to be active, became ill with the typical elevation of temperature, but without developing any lesions in the mouth or on the feet. Only the calf inoculated after the twelve days' interval showed several small abortive vesicles at the seat of inoculation in the mouth. Not one of the animals (four yearlings and twelve calves) which has come through an attack of the disease has had a second attack, although attempts have repeatedly been made to re-infect them with fresh material.

On the 9th of March two calves received by subcutaneous injection from 10 to 15 ccm. of blood serum from an ox suffering from the disease in an acute form. Both of the calves were inoculated again after seventeen days with the fresh contents of vesicles from the mouth, and as a result both became diseased, with moderate elevation of temperature and the formation of typical large vesicles in the mouth. A third calf which, on the 17th March, had received by subcutaneous injection 10 ccm. of serum taken from a typically diseased calf three days after its inoculation, was re-inoculated nine days later with active material. It reacted on the next day with an elevation of temperature, but did not contract the disease.

II.

BERLIN, *14th August* 1897.

Method of Infection.—Through numerous comparative experiments it has been ascertained that the most certain method of infection is the introduction into the blood stream of the virus found in the contents of vesicles. Success has also attended the introduction of the virus into the peritoneal cavity, injection into the muscles, and rubbing of it into the mucous membrane of the mouth after wounding by pricking. On the contrary, inoculations into and under the skin have proved uncertain. Both of these appear to be effective only when at the same time the virus is introduced into a blood vessel. From the moment that the temperature begins to rise till the development of the local symptoms of the disease, the virus circulates in the blood stream, but it disappears from the blood after the development of the local lesions. The disease could be conveyed to healthy animals with from 50 to 100 ccm. of blood taken from the jugular vein of an animal twenty to twenty-eight hours after its inoculation.

After the introduction of the virus into the blood stream, the local lesions develop in quite a regular order thus:—

After from twenty-four to forty-eight hours the vesicles appear in the mouth, and in milch cows on the udder. After about other twenty-four hours the vesicles appear on the feet, and usually on all four at the same time. Putting aside the method of infection, the quickness with which the disease appears, and the intensity of the local lesions, depend upon the quantity and the virulence of the lymph.

Keeping Power of the Lymph.—The virus present in the contents of vesicles was rendered inactive:—

1. By twenty-four hours drying at summer temperature (maximum 31° C. at mid-day).

2. By heating at 37° C. for twelve hours (the effect of a shorter exposure at the same temperature was not tried).

3. By heating for half an hour at 70° C.

4. Heating for an hour at 60° makes the virus inactive. In one case, however, in which a large quantity of lymph was heated for half an hour at 60°, and then injected into an animal, a typical attack of the disease was set up. This observation shows that at the temperature mentioned a number of the germs are able to withstand exposure for half an hour.

Lymph in capillary tubes kept in an ice chest was certainly infective after fourteen days. After three weeks it was sometimes inactive, but even after having been kept for eight or nine weeks in the ice chest many samples of lymph were found to be capable of setting up the disease when injected in large quantities.

Quantity of Lymph necessary for Infection.—Fresh lymph was accurately measured and afterwards diluted with tap water which had been boiled, and experiments made with this mixture showed that $\frac{1}{5000}$ ccm. was certainly infective. With smaller quantities, from $\frac{1}{10.000}$ ccm. to $\frac{1}{20.000}$ ccm., failures occurred, and infection could not be obtained with quantities of from $\frac{1}{50.000}$ ccm. to $\frac{1}{100.000}$ ccm.

Acquired Immunity.—The investigations of the Commission were mainly directed to determining whether animals which have come through an attack of the disease have thereby acquired immunity against a later infection. Only if this question can be answered in the positive sense is there a hope of being able to successfully deal with the disease.

Attempts have repeatedly been made to confer an individual protection on susceptible animals, but hitherto all experiments in this direction have failed to yield practical results. Most veterinary authorities have declared that there is no hope of doing anything in this direction, since it is alleged that one attack of the natural disease does not leave behind it any immunity. In consequence of these opinions, the Commission would have thought it hopeless to go into the question of immunity in foot-and-mouth disease had they not observed that a number of their own experimental animals were undoubtedly immune after having come through an attack of the disease. Repeated re-inoculation of animals that had had an attack showed that in the great majority of cases, in calves and adult cattle, immunity is present from two to three weeks after the development of the disease. Regarding the duration of this immunity, nothing more can be said at present than that it certainly lasts for five months. However, this immunity is not acquired in every case. Occasional animals when re-inoculated within a month after having suffered from the disease were attacked a second time. After that, however, they were immune. This behaviour of cattle with respect to foot-and-mouth disease corresponds very closely with what is observed in the human subject in regard to measles and small-pox, which are the infectious diseases that with the greatest certainty confer immunity against a second attack. But even in the case of these diseases occasional individuals may suffer from two or even three attacks.

Just as there are animals belonging to the bovine species which are highly susceptible to foot-and-mouth disease, there are others which appear to have a so-called natural immunity.

The Commission instituted a series of experiments, having for their object to discover some practicable method of conferring immunity:—

1. *Experiments with Fresh Lymph.*—Animals which had received into their veins active lymph so far diluted that it was no longer capable of infecting were found to have acquired no immunity. The same was found to be the case

with animals that had been inoculated cutaneously or subcutaneously with undiluted lymph, but had not thereby become infected.

2. *Experiments with Heated Lymph.*—A number of the animals which had been inoculated with lymph rendered inactive by heating showed a certain degree of immunity, especially those which had received large quantities of the lymph. The result, however, was not at all satisfactory, for when the whole of the animals were tested the number that contracted the disease was greater than the number found to be immune.

3. *Inoculation with a Mixture of Vaccine Lymph and Lymph from Foot-and-mouth Disease Vesicles.*—As has already been mentioned, animals which are cutaneously inoculated without contracting the disease do not thereby acquire any immunity. In order to bring about, if possible, a more active localised development of the causal agent of foot-and-mouth disease, experiments were made with mixtures of vaccine lymph and foot-and-mouth disease lymph. Some of the animals in which after inoculation with the mixture only a vaccine lesion developed at the point of inoculation were found when tested three weeks later to be immune against foot-and-mouth disease. On the other hand, inoculation with vaccine lymph alone was found to confer no immunity against foot-and-mouth disease; and, conversely, animals which had come through an attack of foot-and-mouth disease had no immunity against the vaccine lymph. It must therefore be concluded that when the mixed lymphs are inoculated a local multiplication of the causal agent of foot-and-mouth disease does actually take place, and confers immunity.

The experiments with mixed lymph were not pursued further, for it was found that when any bleeding occurred at the point of inoculation the animals were attacked with general foot-and-mouth disease. By means of a hammer heated in boiling water, blisters were raised on the inner surface of the ear, and when foot-and-mouth disease lymph was introduced into these without wounding the base of the blisters the animals did not become affected, and did not acquire any immunity, but if in performing the operation the base of the blister was wounded, so as to cause hæmorrhage, a typical attack of foot-and-mouth disease was the result.

4. *Experiments with the Blood of Immune Animals*—In order to see whether a passive immunity could be conferred on calves by injections of blood from animals which had come through an attack of the disease and subsequently been repeatedly inoculated without result, a series of animals were treated with such "immune blood" in graduated quantities of from 10 to 150 ccm. The animals were then inoculated from twenty-four to seventy-two hours afterwards with the fresh contents of vesicles, with the result that they all contracted the disease in quite a typical form.

5. *Experiments with Mixed Lymph and Immune Blood.*—Experiments were now made to ascertain whether the blood of immune animals when directly mixed with active lymph is capable of robbing the latter of its infective power. Lymph and defibrinated immune blood were mixed in definite proportions, and a series of animals were injected with the mixture. In no case did the injection set up an attack of foot-and-mouth disease, whereas a mixture of lymph and blood from healthy non-immune animals, when used in the same proportions, was found to be without exception infective.

It thus appears that the blood of animals which have come through an attack of the disease prevents an undoubtedly active lymph from exerting its pathogenic properties in the body of a susceptible animal, although the blood of a non-immune animal has no such effect. Hence, during an attack of the disease there are formed in the body of the animal substances which have a specific action on the causal agent of the disease—an observation which is quite analogous to what is known to occur in many other infectious diseases.

The injection of a mixture of lymph and immune blood does not make the

animal obviously ill, whether it be injected under the skin or into the blood stream. In some of the animals there was a distinct rise of temperature, up to 40° C. or more, but in others there was no febrile reaction.

It was now of great interest to determine whether the animals had also acquired immunity through inoculation with the mixture of immune blood and lymph. Inasmuch as in natural cases of the disease the immunity appears to set in about three weeks after the attack, the animals treated with the mixture of lymph and blood were isolated as carefully as possible during this period, and then put into byres which were being constantly contaminated by animals recently attacked with foot-and-mouth disease. No disinfection of these byres was practised. After some days the animals were tested by the intravenous injection of active lymph. The great majority of the animals withstood this test, although in similar circumstances untreated animals always contracted the disease. The animals were kept under observation for five weeks, and during that time none of them were attacked.

The experiments of the Commission have thus shown that it is possible to confer an artificial immunity against foot-and-mouth disease on animals. The prospect of being able to introduce a practicable method of protective inoculation has thus been opened up.

III.

BERLIN, *8th January* 1898.

In the preceding report the Commission have shown that it is possible to render healthy animals immune against foot-and-mouth disease. This result was obtainable in several ways, but the best results were obtained by using a mixture of lymph and blood of animals which had themselves acquired immunity in consequence of an attack of the disease. The Commission have therefore endeavoured to develop this method so as to make it available on a large scale as a means of combating the disease. A most important point to determine was the quantity of blood necessary to be added to the active lymph, so that the animals should not be infected by the mixture. With this object a series of inoculations were carried out on calves and pigs, the quantity of lymph being graduated while the quantity of immune blood remained constant in one of the series of experiments, and the quantity of immune blood being varied while the quantity of lymph remained constant in the other series.

These experiments showed that in order to confer immunity on calves the quantity of lymph used must not be too small. The quantity of fresh lymph necessary to immunise a calf was found to be $\frac{1}{40}$ to $\frac{1}{80}$ ccm. The quantity of immune blood to be added to this quantity of lymph was varied within rather wide limits, from 1 to 50 ccm. being employed. Naturally, the smaller the quantity found to be sufficient it would be the more convenient in practice. A series of experiments showed that 1 ccm. of immune blood sufficed to render innocuous the quantity of lymph previously ascertained to be necessary to confer protection. The lymph with which these results were obtained was taken from calves which had been inoculated in continuous series in the Institute. The results were so favourable that by means of this method ($\frac{1}{80}$ ccm. of fresh lymph and 1 ccm. of immune blood), the exact moment at which immunity sets in could be determined. It was found to be about three weeks.

On the ground of the absolutely satisfactory result of these laboratory experiments, it appeared to be justifiable to proceed to test the method in the conditions of everyday practice. An opportunity to do this presented itself in the neighbourhood of Greifswald, where, on two farms, Rappenhagen and

Boltenhagen, belonging to Mrs Becker, the disease broke out in the month of September. The disease had been introduced to Rappenhagen by some newly bought oxen, and it there attacked the draught oxen. It was then carried to Boltenhagen, and there also it attacked the lot of working oxen. From these it spread to the cow byre, in which there were 153 cows, a number of them being heavy in calf, and in the month of September most of these were attacked. At Rappenhagen there was a special shed containing fifty-four three year-old bulls, and at the same place there were at pasture other twenty bulls of from one-and-a-half to two years old. At Boltenhagen, on the other hand, there were two lots of young cattle at pasture, the numbers being thirty-four and thirty-two respectively. At the latter place there were also thirty-eight calves of various ages, some of them being in the cow byres, and the remainder in other sheds. An unusually large stock of cattle were thus threatened with the disease on both farms, and the Commission therefore had an extraordinarily favourable opportunity to test their method of protective inoculation. Abundance of fresh lymph was obtainable from the numerous animals acutely affected with the disease.

The necessary immune blood was easily obtainable from the immune animals kept in the sheds at Berlin. Through a mistake the blood was taken not from the most strongly immunised and repeatedly reinoculated animals, but from an animal which had been immunised by heated lymph and afterwards tested once as to its immunity with virulent lymph. The inoculation of the bulls and young cattle at the two farms was attended with great difficulty; the animals had first to be driven into a corner, and then each had to be lassoed over the horns. The young animals could then without difficulty be injected into the jugular vein, but each of the seventy-four bulls had to be cast and tied, as otherwise the inoculation was attended with danger to the lives of those performing the operation. Two very bad-tempered bulls had to be left uninoculated. All the operations were carried out in a perfectly satisfactory manner, and the results were as follows. The whole of the fifty-four three-year-old bulls were attacked with the disease from the sixth to the tenth day after the inoculation, and the twenty younger bulls after about twelve days. The attacks, however, were so slight that the animals could be left at pasture; only six of the older animals had to be brought into the house on account of vesicles on the feet. The animals continued to eat very well, but went somewhat stiffly on hard ground, and a few of them frothed at the mouth. In the lot of thirty-four young cattle about five were observed to froth at the mouth, and about the same number in the other lot. A number of them went stiffly for some days, but these also had no difficulty in eating, and retained a good appetite. Out of eleven calves which were inoculated in the infected cow-byre, six were removed into another shed immediately after the inoculation. None of these afterwards contracted the disease, even when infected calves were placed along with them. Of the five inoculated calves which were left in the cow-byre, two contracted the disease and three did not, whereas out of ten uninoculated calves left in the cow-byre, all except two were attacked with the disease. An accurate examination of the animals at pasture could, unfortunately, not be carried out, as there were not sufficient attendants to catch and examine every single animal. The owner was very well pleased with the mild and rapid course of the disease among the inoculated animals.

The most remarkable point in connection with these experiments was the fact that a whole series of animals were attacked, though only slightly, from the tenth to the twelfth day after the protective inoculation. The question therefore arises whether these attacks were determined by the protective inoculation itself, or were the result of natural infection of the animals not

yet rendered immune. Inasmuch as no symptoms of the disease were exhibited by the six calves from three to four months old which had been isolated in a separate place immediately after the injection of the mixture of lymph and immune blood, it does not appear probable that the attacks should be laid to the charge of the inoculation itself. The possibility was certainly not excluded that the infection had been carried by the numerous attendants who had to be employed to catch the animals for inoculation in the fields, and who also had to do with diseased animals in the infected byres, although attempts had been made to disinfect their hands, clothes, and boots with sublimate solution. Even although only a few of the animals had been infected by the attendants, it was, of course, possible that these few might have infected the others; and inasmuch as the period of incubation in natural cases of infection is usually from two to six days, the animals which were attacked at the end of the second week might have been infected from others that had contracted the disease spontaneously. It was, unfortunately, impossible to submit the animals in the pastures to a daily examination, and we had to rely on the statements of the attendant, who may easily have overlooked slight cases of the disease. Only in the case of one of the lots of young cattle, numbering thirty-four head, were the animals individually inspected. For this purpose they were brought into the sheds about three week after the inoculation. Two of these animals had not been inoculated, and among the whole lot twenty-two, including the two not inoculated, were found to show slight scars on the jaws, while four had erosions in process of healing, and eight showed no lesions. These facts also speak against the view that the inoculation had infected the animals.

However, the fact that the twenty young bulls were almost simultaneously attacked about twelve days after the inoculation still leaves it possible that these animals had been infected by the inoculation, and this supposition was supported by the result of an experiment which had been begun in Berlin shortly before the inoculations were practised at the above-mentioned farms. In order, if possible, to confer a certain immunity, seven calves, two or three weeks old, after they had been injected with a mixture of immune blood and lymph, were inoculated a second time with the same mixture composed of $\frac{1}{40}$ ccm. lymph and 1 ccm. immune blood. To our great surprise the whole of these animals were attacked towards the end of the second week after the inoculation. In each of them there developed slight, but at the same time unmistakable, lesions of foot-and-mouth disease in the mouth, though certainly not on the feet. This experience was in contrast with everything that we had observed before. The fact that these at one time immunised animals contracted the disease, though only in a mild form, could only be ascribed to the insufficient activity of the immune blood, or to an abnormally high virulence of the lymph employed. The immune blood was the same as had been used for the first immunisation, and, consequently, the cause of the disease must have been the high virulence of the lymph employed for the second protective inoculation; and as a matter of fact the lymph used for this second inoculation came from a severe outbreak of the disease in Posen. It was used for the immunisation experiment twenty-four hours after it was obtained. Since the inoculations at Rappenhagen and Boltenhagen were also made with fresh lymph from a severe type of the disease, it is therefore possible that the infection of the twenty young bulls was determined by this lymph. The lymph which we had used for immunising the various lots came from different animals, and it is very possible that the lymph employed to inoculate these bulls may have been specially virulent.

It thus appeared that in experiments regarding immunisation by means of a mixture of blood and lymph, the virulence of the lymph as well as its quantity is an essential factor. It had therefore to be ascertained by new

experiments whether and by what quantity of immune blood this highly virulent lymph could be made safe for the animals to be inoculated. The experiments carried out with this object showed that $\frac{1}{10}$ ccm. of this highly virulent lymph could, by admixture with 10 ccm. of defibrinated blood from a well-immunised animal, be so influenced that the animals therewith inoculated either did not develop any disease or showed only some slight alterations in the mouth, unaccompanied by any injurious effect on the general health. These alterations, which were observed in a number of animals from ten to fourteen days after the protective inoculation, took the form of flat, circular, or streak-like exfoliation of the epithelium, occurring at the places where the characteristic vesicles are formed. These erosions are usually associated with accumulation of a blackish or brownish pigment.

Without careful daily examination of the animals these alterations, occurring so long after inoculation, would doubtless have been overlooked, inasmuch as the animals did not exhibit any other symptoms of disease. We were also for a long time in doubt whether they ought to be regarded as belonging to foot-and-mouth disease at all. However, since they were exclusively found in animals which had been injected with the mixture of immune blood and lymph, we arrived at the conviction that they could be nothing else than quite mild abortive products of the virus which had been weakened by the immune blood. In pigs which were treated by the same mixture of immune blood and lymph we have never observed such local alterations.

Through some experiments we have been able to convince ourselves that it is not necessary to mix the lymph and immune blood intimately with one another before injecting the mixture. The lymph was also rendered innocuous when it was separately injected into the jugular vein, followed by the injection of immune blood into the corresponding vein of the opposite side.

With regard to the immunising effect of the injection of lymph and immunised blood, we have ascertained that in the case of pigs, which are but slightly susceptible to the disease, about 95 per cent., and in the case of highly susceptible calves about 75 per cent., three weeks after the protective inoculation will bear, without afterwards exhibiting any symptoms of disease, the intravenous injection of 100 times the quantity of lymph which will suffice to infect an unprotected animal. This result must be regarded as very satisfactory, in view of the fact that not every animal that has come through an attack of the disease is thereby rendered immune. Should the infection be introduced into a lot of animals that have been submitted to protective inoculation, at the most a quarter of them will become infected. The danger of such introduction of the disease, however, will be relatively slight, seeing that the virus so introduced will find only a small number of susceptible individuals. The animals which have not been certainly immunised will derive protection from the fact that they are found in the company of animals that are protected, the conditions being similar to those which are observed with regard to vaccination against smallpox, where the individuals that have acquired little or no immunity are protected by the fact that the immense majority of persons have been certainly immunised. In our opinion, therefore, the practicability of the procedure is beyond question, although the ideal effect of conferring immunity on every animal in the herd has not been attained.

Before introducing the procedure into practice, it will be necessary to test it experimentally on a series of adult cattle. It is conceivable that the greater body-weight of adult animals may require the employment of a larger quantity of immune blood than is necessary for the immunisation of calves. It is also desirable to ascertain by accurate experiments whether the continued introduction of gradually increasing quantities of lymph into the blood stream of immunised animals will heighten the activity of the immune blood, so that

a smaller quantity than 10 ccm. of it might be employed for protective inoculation. Inasmuch as the virulence of the lymph is notoriously very variable in different outbreaks of the disease, experiments regarding the obtaining of lymph as constant in strength as possible require to be taken in hand.

Apart from the before-described results touching the practical question of immunisation, the Commission have still to report regarding others which are of no slight scientific interest, and which, as far as one can judge at present, have a far-reaching importance for the future investigation not only of foot-and-mouth disease but also of numerous other infectious diseases of man and animals.

In their endeavours to discover a practicable method of conferring immunity, the Commission have not confined themselves to experiments regarding the method of immunising by means of a mixture of immune blood and lymph, but have also taken into consideration other possible methods of conferring immunity, such as the introduction of blood from an animal at the acute stage of the disease, with or without the addition of immune blood, or the employment of lymph which has been freed from its corpuscular elements by filtration. It may immediately be said that the whole of these experiments have not yielded satisfactory results; on the other hand, the filtration experiments have yielded results which are of importance in the direction above indicated. In these experiments the lymph was diluted with thirty-nine parts of water, and to the mixture there was then added a large quantity of culture of an easily recognised species of bacterium, namely, the bacillus fluorescens. The liquid was then filtered two or three times through an unglazed porcelain filter. The object of adding the bacteria was to be able to ascertain by inoculating nutrient media with large quantities of the liquid whether the same was germ free. When no colonies of bacteria developed it could be concluded that all the bacterial elements present in the lymph had been kept back by the filter. The filtrate when tested in this way was always found to be free from bacteria. With this filtrate a series of calves were inoculated, quantities varying from $\frac{1}{10}$ to $\frac{1}{40}$ ccm. of the pure lymph being injected into the blood-stream in order to ascertain whether immunity could be conferred by any of the substances present in solution in the lymph.

The result of these injections was somewhat surprising. The animals which received the filtrate contracted the disease in the same time as control animals which had received a corresponding quantity of unfiltered lymph, and they all showed typical symptoms of the disease, with high fever and the development of vesicles in the mouth and on the feet. It appeared as if the activity of the lymph had not been affected by the filtration. In order to be quite certain regarding this point the experiments were several times repeated on a large number of calves and pigs. When fresh lymph was used the results were always the same, the animals treated with the filtered lymph always becoming affected in a quite typical way, just like the control animals treated with unfiltered lymph.

How was this striking fact to be explained? Two alternative explanations offered themselves—either the germ-free filtered lymph contained in solution some extraordinarily active poison, or the hitherto undiscoverable agent of the disease was so small that it could pass through the pores of a filter which will certainly keep back the smallest of the known bacteria. If the first explanation is the correct one, the soluble poison must be an amazingly active one. With a quantity of filtrate corresponding to $\frac{1}{30}$ ccm. of lymph, the disease could be set up in two days in calves of about 200 kg. In his experiments Brieger obtained bouillon cultures of the tetanus bacillus which were so strong that ·0005 ccm. of the germ-free filtrate sufficed to kill a mouse; that is to say, 1 ccm. would kill 20,000 mice, and 1 litre would kill 20,000,000 of them. From this bouillon he obtained 1 gramme of a substance of which

·0000001 gr. killed a mouse; that is to say, 1 gramme of this substance would have sufficed to kill 10,000,000 mice. Judged by the lethal activity of the filtrate, 1 gramme of the substance ought to have killed 20,000,000 mice, but since it only killed 10,000,000, 1 gramme of the poison had been lost in its preparation. Accordingly, at the most, the poison must have formed $\frac{1}{500}$, or 2 per cent. of the bouillon.

If we now assume that in the lymph of foot-and-mouth disease vesicles the active material constitutes $\frac{1}{500}$ of the lymph, the quantity of this material in $\frac{1}{30}$ cm. of the lymph must be $\frac{1}{15000}$ gr. This quantity sufficed to communicate the disease in a typical way to a calf of 200 kg.; hence, provided that the poison was uniformly distributed throughout the whole body of the animal, one part of the poison must have been active when distributed in 15,000 x 200,000, that is to say, 3,000,000,000 parts of the calf. Out of tetanus cultures Knorr was able to extract a poison whose activity was 1 : 1,000,000 for rabbits; 1 : 150,000,000 for white mice; and 1 : 1,000,000,000 for guinea-pigs. In respect of its activity the toxin of foot-and-mouth disease would, therefore, far exceed that of the strongest tetanus poison. In the foot-and-mouth disease toxin we, therefore, had an agent of most astonishing activity.

Subsequently we were able to communicate the disease in a quite typical way in two days to a pig of about 30 kg. body-weight, by inoculating it with $\frac{1}{50}$ ccm. of lymph obtained from a vesicle on the foot of a calf which had received some of the filtered lymph. The poison must thus have experienced a further dilution of 1 : 50 x 500 x 3000 (750,000,000). It is impossible to believe in a poisonous effect with such a degree of dilution.

In these calculations, as in those relating to the strength of the tetanus poison, it has been assumed that the toxin becomes uniformly distributed throughtout the whole body of the animal into which it is introduced. But it is not certain that such is the case. In the case of a man or animal affected with tetanus, or poisoned with the tetanus toxin, the latter can be detected without difficulty in the whole mass of blood and in all the organs, but one cannot do the same in animals affected with foot-and-mouth disease. Large quantities of the blood of such animals (50 to 100 ccm.) must be used in order to infect healthy animals. It therefore appears to be quite possible that the whole or the greater part of the toxic substance introduced into the blood-stream within a short time afterwards becomes deposited in those parts of the body at which the vesicles develop. If we suppose that, in the case of an animal which has contracted a typical attack of the disease after the injection of $\frac{1}{30}$ ccm. of filtered lymph, the contents of the whole of the vesicles on the feet and in the mouth amount to 5 ccm., then the original quantity of toxin in $\frac{1}{30}$ ccm. of lymph would now be found in 5 ccm. of lymph, since it has been diluted 150 times. But of this lymph $\frac{1}{50}$ ccm. when injected into the veins sufficed to infect a pig of 30 kg. body-weight in two days. Hence, $\frac{1}{7500}$ of lymph, or, calculated at the same rate as in the tetanus experiments, $\frac{1}{3750000}$ of the toxin, must have exerted its action in 30,000 grs. of the pig or in 2000 grs. of blood. Even according to this calculation, the hypothetical toxin of foot-and-mouth disease present in the lymph must have had most remarkable activity. The view, therefore, that the effects of the filtrate were due, not to any soluble substance in the lymph, but to some agent capable of multiplication, cannot be dismissed as improbable, but in that case the agent must be so small that it can pass through the pores of a filter which will certainly keep back even the smallest bacteria. The smallest of the hitherto described bacteria is the influenza bacillus discovered by Pfeiffer. It has a length of from ·5 to 1 μ. If we now assume that the supposed agent of foot-and-mouth disease is not more than $\frac{1}{10}$ or $\frac{1}{5}$ as large as this, then, according to the calculations of Professor Abbe, it would not be

visible under the highest powers of our microscopes, even with the best modern immersion lens. This would furnish a very simple explanation of the futility of attempts to discover the germ in the lymph by means of the microscope.

IV.

BERLIN, 12*th August* 1898.

In the preceding report it was mentioned that the lymph taken from fresh vesicles, when diluted with water and then filtered so as to deprive it of all bacteria, still retains its infective power. Further investigations have established the correctness of this observation beyond any doubt. It has been possible to show that by the aid of such filtered lymph the disease can be transmitted with certainty from animal to animal in a whole series of experiments. In such a series the sixth animal contracted the disease just as promptly as the first.

In support of the view that the agent of infection is some corpuscular element, and not a substance in solution, it was on many occasions observed that diluted lymph which was repeatedly passed through a thick Kitasato filter would no longer infect susceptible animals, even when one used a quantity of it representing $\frac{1}{30}$ ccm. of the pure lymph. Apparently the agent of infection had been kept back in the narrow pores of the Kitasato filter. Before carrying out the experiments in which the disease was transmitted in succession to a series of six animals by means of filtered lymph, it had to be shown experimentally that it was possible to do this with unfiltered lymph. The first experiments made in this latter direction did not at once give satisfactory results. After the fourth, and frequently even after the third transference, the virulence was found to be very notably diminished. At first the animals took the disease in quite a mild form, and subsequently the disease did not appear to be transmitted at all, whether calves or pigs were used for the experiment. However, the difficulty presented by this loss of virulence was overcome by using cattle and pigs alternately in the attempts to carry on the disease. After that it was possible to undertake the experiments with the filtered lymph.

The results of these experiments were of considerable practical importance, inasmuch as they enabled the Commission to obtain a supply of lymph of nearly constant virulence, and thus made them independent of outbreaks in the country, from which they had formerly been obliged to provide themselves with fresh lymph at considerable difficulty and cost.

A means of determining with certainty the degree of virulence of the lymph, by ascertaining the fatal dose for small animals, was not arrived at by the Commission, notwithstanding numerous experiments on mice, young guinea-pigs, young rabbits, young cats, young calves, and various species of small birds. Geese, which according to the views of some observers are very susceptible, withstood the injection of large quantities of lymph (1 ccm.) without any other effect than a rise of temperature. That the strain of lymph used by the Commission had attained a high degree of virulence was shown by the fact that it was found to be possible to infect goats with it, although in the earlier experiments these animals had appeared to be but slightly susceptible (out of eight animals only one was affected). It may be observed that the disease spread spontaneously from two experimentally infected goats to two other healthy goats kept along with them. The virulence of the lymph was further attested by the fact that several dogs (fox-terriers) which were running about in the buildings in which the diseased animals were kept developed symptoms of foot-and-mouth disease.

The Commission also instituted experiments regarding the possibility of infecting animals by introducing the virus into the stomach without allowing

it to come into contact with the mucous membrane of the mouth or upper part of the alimentary tract. A number of animals had administered to them gelatine capsules containing fresh lymph, these being introduced so far into the gullet that the animals were obliged to swallow them. After two or three days all the animals thus infected contracted the disease in a typical way. It must therefore be concluded that natural infection from the alimentary tract ought to be regarded as having considerable importance.

Numerous experiments were instituted regarding the best method of preserving the lymph. These showed that the germ-free filtered lymph retained its activity up to four months when kept in the ice chest. The addition of phenol, thymol, or even ·5 per cent. of carbolic acid, did not appear to have any special importance.

Lymph diluted with ten times its volume of water and then rendered germ-free by filtration was found to have retained its virulence unaffected after eleven weeks, notwithstanding the addition of 1 per cent. of carbolic acid.

Whereas previous experiments had shown that pure undiluted lymph enclosed in capillary tubes lost its activity in twelve hours at 37° C., the undiluted filtered lymph at the same temperature was certainly infective after twenty-four hours, though it was found to be non-infective after three days.

None of the attempts to cultivate the hypothetical agent of the disease yielded successful results.

Immunisation Procedures.—As already explained in the report of the 8th January, it appeared to be necessary to institute further experiments before employing the method of immunisation devised by the Commission in practice. Such experiments were carried out on a great number of adult animals. In these experiments care was taken that the serum to be added to the lymph was obtained from animals which were able to withstand large doses of lymph without developing any local symptoms of the disease. It was now ascertained that some of the animals protectively inoculated, especially some of the adult cattle, contracted the disease after the injection of lymph and serum, whether 1, 5, 10, 20, 50, or 100 ccm. of serum had been mixed with $\frac{1}{50}$ ccm. of lymph. Even when the quantity of lymph was reduced to $\frac{1}{100}$ or to $\frac{1}{200}$ ccm. occasional animals still developed the disease, generally during the second week, about the tenth or twelfth day. Obviously if such results as this had to be expected in practice, protective inoculation on a large scale could not be carried out. The possibility of such an occurrence must in every case be excluded.

Experiments were, therefore, made with the serum from various species of animals after these had been repeatedly injected with large quantities of lymph. It was thus ascertained that, apart from cattle and pigs, the serum of horses and goats can be used to furnish the active agent of immunisation. For this purpose, on the other hand, the serum of geese was found to be nearly useless. However, even when the serum was taken from animals which had previovsly been injected with very large doses of lymph, occasional cases of disease were observed in the animals protectively inoculated with a mixture of the serum and lymph. In subsequent experiments the mixture of serum and lymph was not immediately injected, but allowed to stand for some time before it was used for protective inoculation, and it was observed that cases of the disease no longer occurred in consequence of the injection, provided the lymph and serum had been left for a sufficient time in contact.

It had then to be ascertained whether the animals thus treated had actually acquired immunity. Experiments to this end showed that almost without exception the animals, three weeks after the protective inoculation, could withstand a test inoculation with $\frac{1}{50}$ ccm. of the highly virulent lymph. Immunity set in even when the mixture of serum and lymph (10 to 20 ccm.

serum with $\frac{1}{50}$ ccm. lymph) had been prepared four weeks before it was injected. Immunisation was obtained quite as well in pigs as in cattle.

The activity of the sera of immune animals is subject to very considerable individual variations. Some animals furnish a serum so active that animals inoculated with a mixture of it and lymph will not contract the disease even when they are immediately placed in infected premises between animals suffering from the disease; indeed, they may withstand the intravenous injection of $\frac{1}{100}$ ccm. of lymph ten days after the protective inoculation.

In addition to the method of immunising by means of a mixture of serum and lymph, the Commission discovered still another method which, without doubt, might be employed to confer protection. As has already been mentioned, the filtered lymph loses its activity after several months. The lymph which has thus become inactive, when injected into healthy animals, protects them without setting up the slightest symptom of disease. All the animals thus treated with lymph which had been kept for six months were found to be immune when tested three weeks afterwards with $\frac{1}{50}$ ccm. of highly virulent lymph.

Opportunities to make extensive observations regarding the duration of the artificial immunity did not present themselves. Some animals (adult cattle and calves) which were set aside for this purpose were found to be quiet immune when tested three months after the protective inoculation.

The Commission made an interesting observation regarding the hereditary transmission of immunity. They had kept one of the first heifers which came through an attack of the disease, in order to subsequently test the duration of the animal's immunity. From time to time it received large quantities of lymph, and its serum was repeatedly used with success for immunising purposes. This animal gave birth to a calf on the 8th of May 1898, and three days afterwards $\frac{1}{100}$ ccm. of highly virulent lymph was administered intravenously to the calf. It did not become affected. Six days later it received the large dose of $\frac{1}{10}$ ccm. without developing the slightest reaction, and when afterwards placed in an infected byre it remained healthy.

In order to see whether any immunising substances are present in the milk of immune cows, the calf dropped by the experimental cow was taken away three days after its birth, and two recently purchased sucking calves were put to the cow. Fourteen days after this one of the calves was spontaneously attacked with foot-and-mouth disease, another experimental animal having developed the disease in the same premises. The second sucking calf contracted the disease in a typical way after the injection of $\frac{1}{200}$ ccm. of lymph; hence, nourishment for fourteen days with the milk of a certainly immune animal had not sufficed to protect either of the calves.

PRINTED BY W. AND A. K. JOHNSTON, EDINBURGH AND LONDON.

THE JOURNAL OF COMPARATIVE PATHOLOGY AND THERAPEUTICS.

VOL. XII.—NO. 2. JUNE 30, 1899. PRICE 2s. 6d.

CANINE AND FELINE SURGERY.[1]

(*Continued.*)

By F. HOBDAY, F.R.C.V.S., Royal Veterinary College, London.

Treatment of Wounds; Methods of Allaying Hæmorrhage, Suturing, Bandaging, etc.

IN the dog and cat wounds, as a rule, heal very well when properly attended to, and the animal is prevented from causing undue irritation by constant licking. In the cat, particularly, this licking of the wound is often a source of trouble, and greatly retards healing, owing to the roughness of the tongue. The chief principles to observe are those of thorough cleanliness, the application as often as necessary of some antiseptic dressing, and the avoidance of all sources of irritation.

The hair at the edges of a wound should always be removed either by being clipped close with scissors or, better still, by shaving; the wound and its surroundings being thoroughly cleansed with soap and water, and dressed with antiseptics.

If freshly made all blood clots and foreign bodies should be removed from between the edges, the latter being drawn together by sutures, and then bandaged or not at the discretion of the surgeon.

Hæmorrhage is arrested by means of pressure applied above or immediately around the bleeding part; this can be done by the aid of a tourniquet made of tape or elastic. The cut ends of the vessels are then sought for and secured by artery forceps, of which there are

[1] Copyright by the author.

several patterns in common use. In extreme cases it may even be necessary to cut down upon the vessel above the original wound and here ligature it.

Spencer Wells' *Pean's.* *Dieffenbach's or Bull-dog.*

FIG. 22.
Artery forceps of different patterns.

When secured, the forceps are left on for some little time, or else the end of the artery is ligatured with some aseptic material such as boiled silk.

In cases where the edges cannot be drawn together, or in which it is not considered advisable to adopt such a course, the thorough application of antiseptics must be resorted to, either by application on clean wadding or with a syringe. Syringes should be made of some material which can be rigorously cleaned.

Dry antiseptic dressings are applied usually by being dusted on the parts with the aid of a piece of wadding, or, if at all deep seated, by means of an insufflator of some pattern or other.

FIG. 23.
Insufflator for the application of dry dressings.

The list of fluid antiseptics commonly used for wounds is the same as that already mentioned when speaking of those used for instruments. Dry antiseptic dressings include such agents as boracic acid,

zinc oxide, iodoform, thioform, orthoform, starch, alum, tannic acid, etc., either alone or mixed together in various proportions. Those that are at all toxic, such as iodoform, must be used with great caution, as absorption may take place, and particularly if on a part which the animal can reach with its tongue, as poisonous effects are apt to ensue.

For operation wounds, after applying sutures and thoroughly drying with aseptic cotton wool, a useful dressing is formed either by iodoform or collodion (1 to 10 or 12), or orthoform and collodion (1 to 8 or 10). Both of these mixtures allay irritation and protect the wound effectually for a short time from dust and dirt.

Möller[1] recommends a wound gelatine which has the advantage of adhering equally well to moist or dry surfaces. It is prepared by soaking ordinary sheet gelatine in sufficient quantity of a one per cent. sublimate solution to cover it. After it has become quite soft it is melted by gentle heat and a quantity of glycerine equal to one-tenth of the dry gelatine added. When required for use it is melted over a slow fire and painted over the wound.

The Suturing of Wounds.

Various forms of sutures are used for drawing together the edges of wounds, the two chief divisions being the "interrupted" and the "continuous."

The principal subdivisions of interrupted sutures suitable for canine work are: simple interrupted, pin, button, or quill sutures, and Lembert's.

The principal continuous sutures are: simple continuous, furrier's, and Halstead's.

The materials used are: silk, Chinese twist, horse hair, wire, catgut, kangaroo tendon, silk-worm gut, and thread. Each of these can be obtained in various sizes.

Whatever material is used, it must be rendered aseptic before being used, or pus is liable to form in the suture holes and retard the healing process. Catgut and silk-worm gut, especially the latter, do

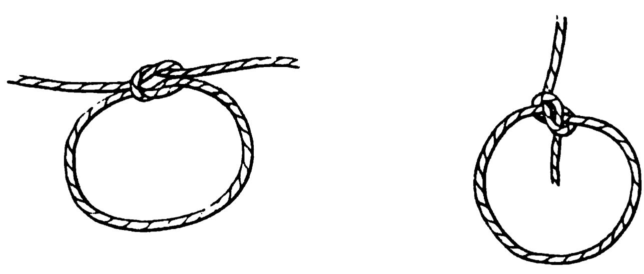


FIG. 24.

Showing how the ends of the silk fall in a "surgical" and a "granny" knot respectively.

not become absorbed for a considerable length of time, and are valuable in cases where it is required that the sutures shall remain in for a long period; silk-worm gut is particularly good for the abdominal wall, because it does not possess capillarity.

[1] Möller's "Veterinary Surgery" (Dollar's translation), p. 2.

Simple interrupted sutures are those in which each suture is complete in itself and entirely separated from the others. They are made by passing the needle and suture material through the edges of the wound and tying the suture carefully in some form of knot which is not liable to slip. The best pattern of knot for this purpose is variously known as a "surgical," "Staffordshire," or "reef" knot, and is so arranged that when completed the loose ends fall opposite to one another at right angles to the wound, and directly over the suture itself. The knot may be left directly in the centre, or, what is probably a better plan because it causes less irritation, pulled to one side. When the loose ends fall in the same line as the wound and at right angles to the suture the knot is apt to slip or give way; this is termed a "granny" knot.

Simple interrupted sutures are suitable for many kinds of surgical work, and should be inserted from a quarter to half-an-inch apart.

Pin Sutures are not so commonly used in the surgery of the dog and cat as in that of the larger animals. They are made by passing clean pins through the two edges of the wound, and afterwards twisting aseptic silk, tow, hair, or some such material over the pin in a figure of 8 fashion. They should not be inserted quite so close to one another as in the case of ordinary interrupted sutures.

Button Sutures are particularly useful for large wounds, where the edges are thin and apt to tear away. In making them, button-shaped

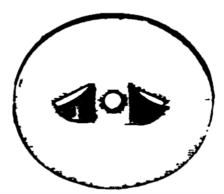


FIG. 25.
Suture button (Pugh's).

pieces of bone (or some hard easily-cleansed material) are used, the suture being passed through the edges of the wound, then through a

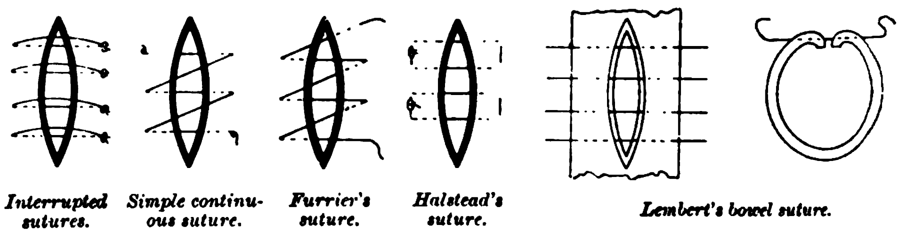
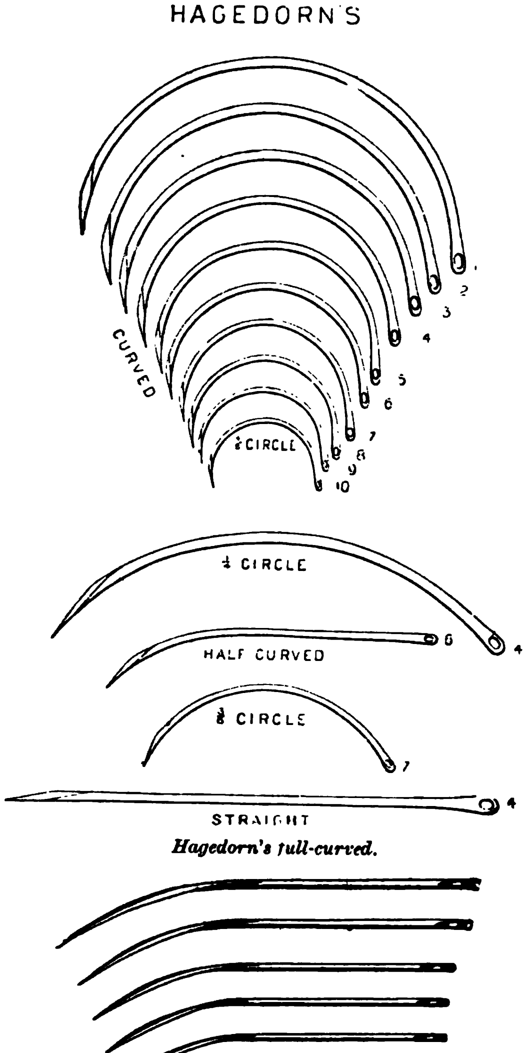


FIG. 26.[1]
Showing different patterns of sutures.

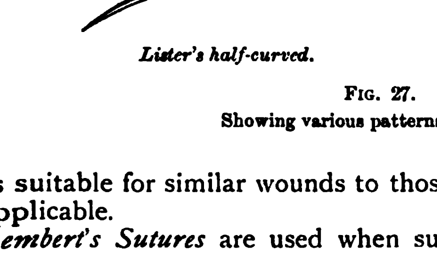
hole in the button on the opposite side, and fastened in some way suitable to the special pattern of button used.

[1] For this drawing I am indebted to Mr D. Crole.

Quill Sutures are similar in principle to button sutures, with the exception that an ordinary quill or piece of wood of that shape is fixed on either side of the edges of the wound by the silk or thread.

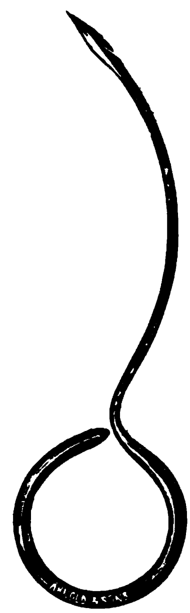


Hagedorn's full-curved.



Lister's half-curved.

Needle with bayonet point.



Needle and holder combined.

FIG. 27.
Showing various patterns of needles.

It is suitable for similar wounds to those in which the button suture is applicable.

Lembert's Sutures are used when suturing the bowel, bladder, or uterus. They are made by passing interrupted sutures through the

serous and muscular coats, great care being taken to avoid puncturing the internal or mucous coat, and to ultimately bring the two serous surfaces well into contact with one another. Small round sewing needles are the best ones to use when inserting these sutures, as if a flat or bayonet-pointed needle be used the sutures are apt to tear out.

The *Simple Continuous Suture* requires no explanation; it is particularly used for suturing the peritoneum where considered necessary after abdominal operations, and for the skin where the sutures are only intended to be temporary, and where the wound is to be re-opened.

The *Furrier's Suture* is not a suitable one where quick healing is desired, as the suture material passes between the edges of the wound, thus causing irritation.

Halstead's Suture is very useful for some wounds, and is made by passing the suture through the wound, then returning it and tying off on the proximal side. Care must be taken that it is not drawn so tight as to wrinkle the skin, or healing will be retarded.

The *Needles* used for suture purposes are of various sizes, shapes, and patterns. They may be straight, curved, half-curved, round, flattened either from above to below or from side to side, bayonet-pointed, with chisel-shaped ends or merely sharpened. They may or may not be fixed in a handle, according to the fancy of the operator and the kind of work required of them.

For carrying wire an improved pattern is that designed by Mr H. C. Reeks, M.R.C.V.S., which has a tubular end and two hollow

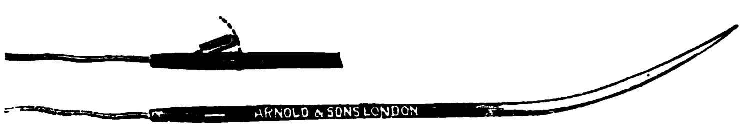


FIG. 28.
Wire suture needle (Reeks').

spaces, so arranged that the wire falls into a slot prepared for it, and does not in any way interfere with the passing of the sutures.

A needle-holder, of which there are several patterns, is often a

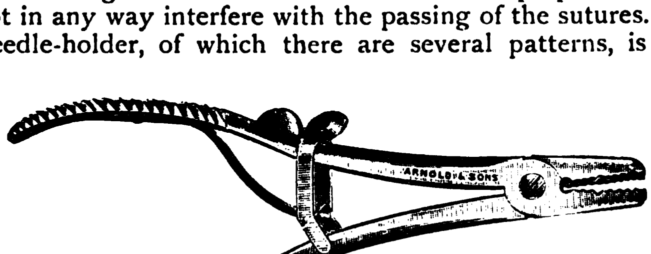


FIG. 29.
Needle holder.

useful accessory; a pair of Spencer Wells' artery forceps form a fairly efficient substitute.

Bandaging.

It is frequently necessary to bandage a wound, and different forms of bandages are used for different parts of the body. For the limbs an ordinary roll bandage, either broad or narrow, is suitable. Tape forms one of the best materials for a narrow bandage, especially when a wound of the digits has to be attended to, and it can be purchased in different widths. For the body the roll bandage, especially a broad one, is again useful, and if inclined to slip over the hind quarters it must be attached to a collar placed round the neck.

A convenient body bandage can be made out of a broad piece of linen by cutting holes through which the legs are passed, and sewing up or tying the edges with tapes along the centre of the back. Holes are made in the neighbourhood of the penis or vagina and anus in order to prevent soiling, and pleats are taken in where requisite in order to make it comfortable and fit tight to the body.

Surgical Treatment of Abscesses.

An abscess when just ripe and ready to open, should be lanced in its softest and most dependent part, the blade of the knife being protected by the fingers (or by some tow or wadding wrapped round it) from entering too deeply, and the cutting action made in a direction away from the animal's body. This operation, which is a very simple one, requires the aid of a sharp scalpel or lancet, the pattern of blades known as Syme's or Paget's, being especially adapted for the purpose. A bold incision should be made, sufficiently large to enable the interior to be thoroughly cleansed and examined after the contents have been evacuated.

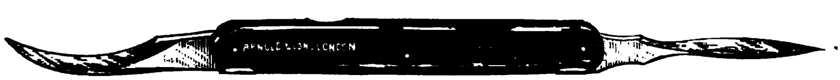


Fig. 30.
Abscess knife (Syme's and Paget's blades).

If there is doubt about the contents an exploratory puncture may be made with a small trocar and canula or an exploring needle; the latter consists of a needle with a fixed handle and having a groove down one side of the blade, the groove being for the purpose of retaining a small quantity of the contents in order that the nature of them may be examined before deciding whether the swelling is to be lanced or not.

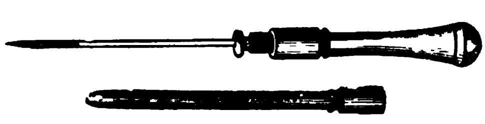


Fig. 31.
Exploring trocar and canula.

The wound is afterwards treated with antiseptics either applied in the form of fluid injections or dry powder, a drainage tube or tent of

antiseptic material being inserted for a few days in order to insure free drainage. If necessary a local anæsthetic may be used over the spot where the incision is to be made, the ether spray or ethyl-chloride being easy of application and very effective.

Exploring, Opening, and Cleansing of Sinuses.

For exploring sinuous wounds in order to ascertain their depth, a probe, usually made of metal or whalebone, is carefully inserted into the orifice and passed inwards as far as possible. This must be done in a very delicate manner, especially in the case of wounds in the

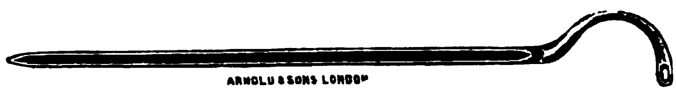


FIG. 32.
Director and blunt needle combined.

neighbourhood of joints or of any vital organs. Having ascertained the depth, if thought desirable to open it up and so make a clean

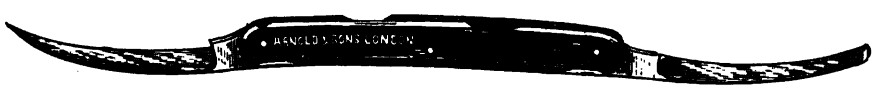


FIG. 33.
Bistoury with sharp and blunt pointed blade.

open wound, a director is inserted and the sinus laid bare by means of a bistoury; the latter instrument may have either a sharp or a blunt point.

If, instead of laying the sinus open, it is considered desirable to

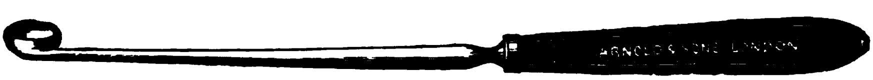


FIG. 34.
Curette or Volkman's spoon.

scrape the interior, this is done by the aid of a curette or Volkman's spoon.

Curettes are made in different sizes, and the spoon-shaped part may have its edge sharp or blunt.

Removal of Cysts.

The removal of a cyst is best effected by completely dissecting around its external wall, and so endeavouring to remove it in its entirety without evacuating the contents. In some cases, however, the contents, or a portion of them, have to be removed on account of lessening risk of injuring surrounding structures, but care must always be taken to remove the whole of the surrounding membrane. If the precaution is neglected the cyst is apt to form again and refill. Cysts are met with in various parts of the body, but particularly in the intermaxillary space, where their complete obliteration is often a matter of great difficulty.

Removal of Tumours.

Tumours in the dog and cat are often of very large size ; they may appear in any region of the body, either externally or internally, and they may be malignant or benign, single or multiple.

In the case of malignant growths the benefit accorded by operative measures can only be temporary ; whatever the variety the principles of removal by surgical methods are the same. In those which have a distinct pedicle a ligature of silk, catgut, horsehair, or some such material may be tied firmly around this part and the tumour removed at once with a sharp knife, or the ligature may be allowed to remain on for two or three days before removal. In some cases resort is made to the actual cautery and clam, or the écraseur may be used. When the

FIG. 35.
Ecraseur with wire.

latter instrument is employed the skin should first be cut through, as, if left, the traction on this caused by the chain or wire gives

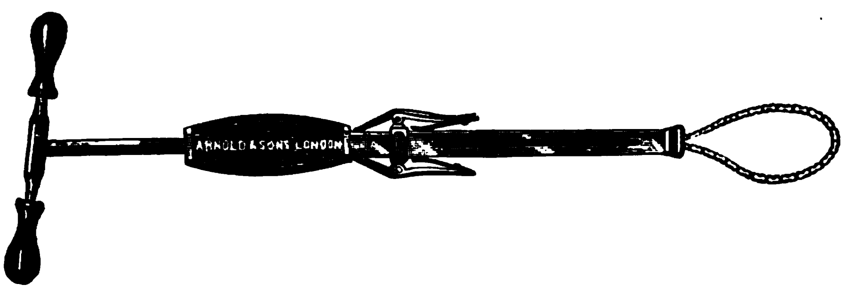


FIG. 36.
Ecraseur (Chassaignac's) with chain.

excessive pain unless an anæsthetic is used, and in addition damages the edges somewhat severely.

In removing large tumours the hair over the line of incision is

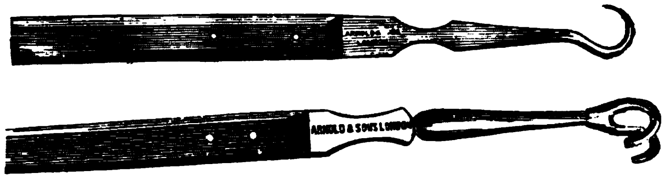


FIG. 37.
Tumour hooks of different patterns.

removed by shaving, the parts being thoroughly cleansed and washed with some antiseptic, and an incision made over what is

thought to be the most convenient part. Cutaneous hæmorrhage is arrested by the application of artery forceps (for which purpose the Spencer Wells or bull-dog patterns are the most convenient), and the skin carefully dissected off around the growth, the latter being raised by a tumour hook or by passing a needle and strong silk through it in order to make a loop to take hold of.

Having kept the parts neatly cleansed with tampons of aseptic cotton-wool, and taken up the vessels wherever necessary with artery forceps, the tumour should be carefully dissected to its base; here, as a rule, will be found the main blood supply, which needs to be secured either by a ligature or by torsion in order to prevent hæmorrhage. A cut with a scalpel completes the removal, or if the ecraseur is to be employed, the chain is now put on and tightened very slowly until excision is complete. The edges of the skin are trimmed and sutured, a drainage tube inserted in position if considered necessary, and the parts treated antiseptically as an ordinary surgical wound.

Operations on the Skull.

Trephining.—The operation of trephining the skull or face is occasionally resorted to after severe injuries, in order to remove foreign material from underneath or to raise depressed pieces of bone. It is also of value in some dental cases.

The instruments required are a sharp scalpel, dissecting forceps, artery forceps, a curved piece of metal to use as an elevator, a small sized trephine, and a strong gimlet.

The operation is performed as follows:—

The animal is secured in the abdominal position and anæsthetised, the hair having been previously removed by shaving from the seat

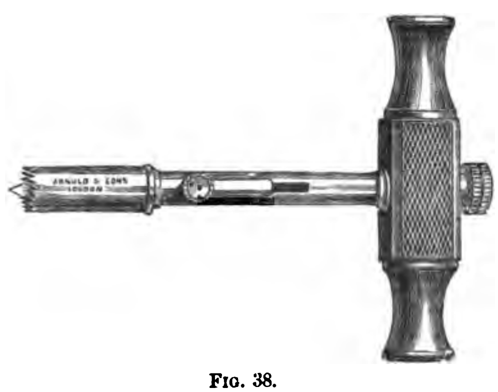


FIG. 38.
Trephine.

of operation and the parts thoroughly disinfected. A crucial or T-shaped incision is made over the spot, and all tissues between that and the bone carefully removed by cutting or scraping. A hole, intended for the insertion of the central pin, is bored with a gimlet in the middle of the spot to be operated upon and the trephine applied. This instrument is worked steadily and carefully to and fro in a rotatory manner until it is felt to have almost penentrated the bone. One side is then slightly depressed in order to cause the

piece of bone in the trephine to become elevated on one side, and so attach itself to the instrument when the latter is withdrawn, instead of falling into the cavity underneath. The foreign body is then sought for, or the purpose of the operation accomplished, the skin afterwards being sutured over the part, and the whole covered with antiseptic dressings and bandaged or left open according to the discretion of the operator.

Operations on the Ear.

Examination of the Interior before, and Application of Dressings after, an Operation.—A cursory examination of the interior of the ear can be made with the fingers, but a speculum of some pattern or other is

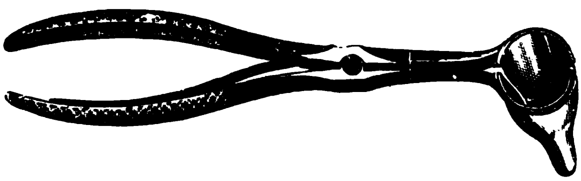


FIG. 39.
Kramer's speculum.

always an advantage, as by its aid dressings can be much more easily applied and any irritant matter more easily removed. There

FIG. 40.
Avery's speculum.

are several patterns which are convenient for canine work, the two most useful being Kramer's and Avery's.

Dressings may be applied on wadding by the aid of a slender pair of forceps or on the end of a fine probe; for fluids a syringe with a curved and protected nozzle has been devised or an ear sponge can be used, whilst for powders after the cavity has been rendered thoroughly dry an insufflator is very useful.

Whatever method is adopted, dressings for the interior should always be applied as gently as possible, because, especially when wounded or irritated, it is extremely sensitive.

Removal of Polypi, Tumours, or Enlarged Ceruminous Glands.—Abnormal growths in this region are best removed by ligature if they are so situated that one can be successfully applied. In other cases the scalpel must be resorted to and the subsequent hæmorrhage

checked by the application of astringents and pressure. Subsequent treatment must be left to the discretion of the operator, as frequently these growths are very troublesome and reappear larger than before after a short period of time.

Operations for Hæmatoma or Tumefied Flap.—This condition is sometimes spoken of as serous cyst, abscess, or blood tumour, of the ear.

A common method of treatment consists in merely lancing the under surface of the ear-flap, carefully pressing out its contents, and treating the wound antiseptically. Some practitioners afterwards insert a plug of cotton-wool or tow, in order to prevent too rapid healing by keeping the edges of the wound apart, or inject concentrated solutions of iodine.

Another method consists in inserting a seton tape through the swollen under part, and so endeavouring to keep up a continual drainage until all the fluid has escaped, and a certain amount of adhesion has taken place between the skin and cartilage.

A third operation, which seems to give by far the best and quickest result, is performed as follows: The ear is carefully washed and dried with antiseptic precautions, the hair being removed, and a plug of dry wadding placed in the aural orifice; the parts are painted with a strong solution of cocaine, or the animal is anæsthetised, and a good longitudinal incision made in the under surface. Every particle of clot or fluid is then most carefully removed, and the edges and interior of the wound are dried with aseptic wadding. Suture material is passed at intervals of about a quarter of an inch right through the flap from above to below, across the incision and again to the upper surface, upon which each suture is tied in a surgical knot. The object of this is to produce a firm pressure on the internal surfaces, and at the same time to bring the edges of the incision in contact with each other. This having been completed, and the parts again carefully dried, the whole ear is placed in a pad of antiseptic wadding and bandaged firmly to the head; a cap or net placed over this is of advantage if the animal attempts to remove it.

After-treatment consists in examining the wound once or twice daily, pressing out any fluid which may be present, carefully drying and bandaging again with antiseptic wadding.

The average length of time required to effect a cure is about ten days; in some cases the bandage can be left off within a week, in other cases it will be found necessary to keep up the treatment for a fortnight or even three weeks.

Whichever method of operating is adopted, it will always be found of advantage in the dog to utilise the bandage or ear-cap in order to protect the animal from shaking the head and again bruising the ear. Proper caps or nets for the purpose can be purchased, but an improvised one can readily be made from a piece of linen and a few pieces of tape, which tie underneath the throat and jaw.

In the cat this is not absolutely necessary, as the comparatively short, upstanding, ears of this animal do not allow of the flap being injured so readily as that of the dog when the head is shaken; even here, however, a bandage or cap is often useful, as it gives a certain amount of protection against scratching and rubbing. In applying a bandage care must be taken that it is not put on too tightly, or necrosis

of the extremity of the flap will ensue through interference with the circulation.

In some cases the flap is bandaged flat on to the cheek; in others it is laid back over the forehead or poll; when recovery is protracted it is a wise plan to alternate between the two.

The sequel mostly to be feared is a permanent thickening, or shrinking and consequent deformity of the flap of the ear.

Amputation of the Ear-flap or a portion of it.—This operation is sometimes necessary when the ear gets severely injured or has on it ulcerating wounds which cannot be made to heal. A general anæsthetic is used, and the offending parts are removed either with a sharp pair of scissors or by the aid of a scalpel and some solid substance (such as a clean block of wood) upon which the ear is laid.

In days gone by, when the cropping of dogs' ears was not considered a cruel and unfashionable operation, the usual method adopted was to fix a metal clamp of the required shape to the ear-flap, the projecting parts being removed with a sharp scalpel or razor.

Any cartilage which protrudes should be carefully snipped off, the parts being afterwards treated antiseptically.

Operations on the Eye.

Examination for, and Removal of, Foreign Bodies.—The removal of foreign bodies from the eye can be accomplished quite painlessly under the influence of cocaine, eucaine, or a mixture of the two. A

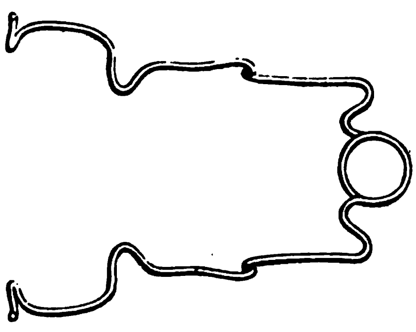


FIG. 41.'
Eye speculum (Bowman's).

small quantity of a 2 to 4 per cent. solution, applied with a camel-hair brush, will produce a very effectual anæsthesia in from one to three minutes. The eyelids are then separated with the fingers or by the aid of a speculum, the foreign body being sought for, and, when found, removed either with forceps, a blunt probe, or some sharp instrument, the choice of which must be determined by the operator. In using anything sharp great care must be taken that the instrument is held in such a way that the cornea will not be injured if the patient unexpectedly moves.

Removal of Dermoid Growths from the Cornea.—In operating upon dermoid growths very great care has to be exercised in order to avoid rupturing the cornea; sometimes the growth is very vascular, and gives trouble on account of hæmorrhage, in which cases cold com-

presses wrung out in boracic solution (about 8 or 10 grains to the ounce) should be applied.

The operation itself consists, after anæsthetising in the usual way with cocaine or eucaine, in carefully dissecting off the growth with a small and very sharp scalpel. It is rarely of permanent value to merely pluck out the hairs, as they almost invariably reappear and cause more irritation than before.

Tapping the Cornea.—This operation is very useful in some cases of staphyloma and ulceration of the cornea where healing is prolonged. It is very simple, and, if done carefully under aseptic precautions, need give rise to no bad results; the object is to relieve the tension produced on the cornea by the aqueous humour, and to thus facilitate the commencement of the healing process. It may have to be done two or three times at short intervals. After the application of cocaine or eucaine solution and some solution of boracic acid as an antiseptic, the patient's head is held firmly by an assistant and the lids forced gently apart by the forefinger and thumb or by a speculum. The operator then plunges a bayonet-pointed or broad-bladed needle through the cornea at its outer margin, and, whilst the thin part of the blade of the needle is in the wound, applies gentle pressure upon the eyeball so as to force out a quantity of the aqueous humour. The needle is withdrawn, and the cornea carefully wiped with boric acid solution. Care must be taken to keep the needle in a direction approximately parallel with the cornea and to avoid injuring the other side of the eyeball, the lens, or the iris.

Operation for Staphyloma.—Staphyloma of the cornea is sometimes conveniently treated by ligature of the protruding portion. For this purpose a very fine thread of silk is passed over the staphyloma, carefully drawn just sufficiently tight to act as a ligature without cutting into the protruding part, and left in that position for one or two days, when the staphyloma is excised.

Previous to the operation the eyeball is prepared by the application of a solution of some antiseptic and local anæsthetic. It is often a matter of difficulty in our patients to keep the ligature in position. In very persistent cases benefit is also derived from allowing the escape of some of the aqueous humour by the operation of tapping the cornea already described.

Operation for Strabismus.—Strabismus or "squint" is not a common deformity in veterinary patients. One case came under observation in the Free Out-patient's Department in March 1895,[1] the animal being a very fat collie dog with a well-marked internal squint in each eye, the pupils appearing to be looking at the nose all the time. The appearance of the animal's face was most ludicrous. The deformity was congenital, the animal being then about three years old. No defect of vision had been observed until during the last three months, when the owner stated that the dog appeared to see imperfectly, and when crossing a crowded thoroughfare had been almost run over on one or two occasions; this latter fact led him to seek professional advice.

The operation for the relief of strabismus is not a difficult one, although requiring a certain delicacy of manipulation of the instru-

[1] "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 250. "Veterinary Record," Vol. VII., p. 688.

ments. Either local or general anæsthesia may be used, the latter being preferable, because the head can be kept perfectly still. The object in operating is to divide the muscle, either the external or internal rectus, which is producing the squint. A speculum is applied to the eyelids, and the conjunctiva at the canthus carefully incised with a pair of fine scissors; a fine blunt hook is passed underneath the rectus muscle, the latter being raised and cut through.

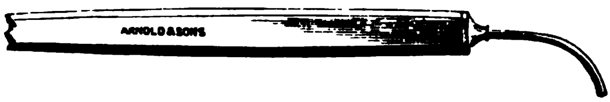


FIG. 42.
Strabismus hook (Walton's).

It may also be advantageous when operating upon the inside to first remove the membrana nictitans. The eyeball is then pulled outwards or inwards, as the case may be, as far as possible.

After-treatment consists in the daily application of some non-irritant antiseptic solution, such as boracic acid (10 grains to the ounce).

The prognosis as to complete return to normal appearance must be guarded, as frequently the improvement is only temporary. In the instance above mentioned, the condition of one eye was decidedly ameliorated, but in the other there was not much alteration; the animal, however, became restored to usefulness as a drover's dog, and the owner noticed a marked improvement in the way it went about its work.

Cataract.—Operative treatment for cataract does not give such successful results in veterinary patients as in those of the human surgeon. A very guarded prognosis should always be given as, although the result may be a restoration to partial vision, it more often leads to disappointment. In the human subject the sight may after the operation be still further improved by spectacles, but in the dog, although these adjuncts have been affixed, there are certain difficulties to be overcome which prevent their general application. The object sought after is the removal of the opacity of the lens. There are several methods of operating, two of which will be described here. A general anæsthetic is advisable, as it is essential that the patient shall keep perfectly still. The eye, the pupil of which has been dilated with atropine, is carefully disinfected with boric acid, perchloride of mercury, or chinosol solution, and a speculum inserted to keep the lids apart. In the first operation an instrument termed a cystotome is passed into the anterior chamber at the margin of the cornea in the direction of the lens, which it scratches several times in such a way as to lacerate its capsule. This procedure may have to be repeated two or three times at intervals of a month or six weeks, the lens itself ultimately undergoing a process of absorption.

The second operation consists in the removal of the entire lens. A special pattern of knife (usually Sichel's or Graefe's) is used in order to puncture the cornea, an entrance being effected on its conjunctival margin, and the point pushed through some distance further along,

the intervening portion of cornea, together with a thin slice of the conjunctiva, being incised. The aqueous humour is allowed to escape, and the capsule of the lens is scratched with a cystotome as

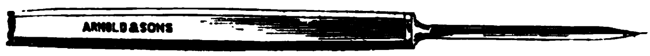


FIG. 43.
Graefe's cataract knife.

described above; gentle pressure with the finger and thumb is put upon the eyeball, and by the aid of a cataract spoon or curette the

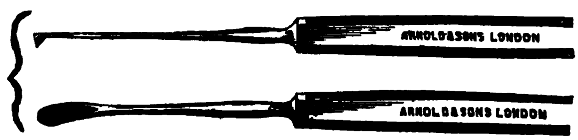


FIG. 44.
Cystotome and curette (Graefe's).

lens is slowly and carefully forced out through the corneal orifice. More antiseptic lotion is then applied, the eyelids being kept closed and covered with an antiseptic pad.

After-treatment consists in keeping the patient in a darkened kennel, and as quiet as possible for about a fortnight or so, the antiseptic pad being changed once or twice a day.

Excision of the Eyeball.—As this operation is a very painful one, some general anæsthetic should always be chosen, except in cases where the eyeball has been forced out of the socket and the posterior portion is exposed. In such instances solution of cocaine (5 to 10 per cent.) answers very well. After having applied the anæsthetic the eyeball itself and its surroundings are washed with some non-irritant antiseptic. The only instruments absolutely necessary are a fine scalpel and forceps, with a sharp hook or pair of toothed forceps to seize the eyeball with; the latter can be improvised by a needle and silk which is passed through the structures of the eyeball and tied in the form of a loop. A fine pair of curved scissors and a wire speculum are also of advantage.

The lids are held apart and the conjunctiva is divided along its upper and lower borders, the eyeball is pulled out and the recti muscles are divided as low down as possible; the last structures to be cut are the optic nerve and vessels at the back of the orbit. Care must be taken to clear out the cavity as neatly as possible

A solution of some styptic, such as liq. ferri. perchlor. is applied on a pad of wadding, the after-treatment consisting merely in the application of antiseptics, a bandage being used where it can be kept on. False eyes of glass, celluloid, vulcanite, etc., of the necessary colour and size can be obtained through an instrument maker or a naturalist, some having a hollow posterior surface and others being solid. The choice must be made in accordance with the condition of the orbit; sometimes granulations occur and almost completely fill up the cavity,

in which case an eye with a hollow back is not so likely to cause irritation. The false eye should not be inserted for at least three or four months after the eyeball has been removed in order to allow for complete healing and also for a certain amount of contraction of the orbit which usually takes place. During the first few days upon which it is inserted the artificial eye should only be allowed to remain for about an hour or so, the time being gradually extended. In all cases it is necessary to remove it each evening for cleansing purposes, as if left in altogether it causes a watery, catarrhal, or even purulent, discharge. The improvement in the appearance of the animal when the false eye is inserted is very great.

Excision of the Membrana Nictitans.—Having secured the patient, cause the head to be held as still as possible in a convenient position for the operation. Paint the upper and lower surfaces of the membrana to be removed with some suitable anæsthetic; allow time for this to act, secure the membrana firmly with a pair of forceps or by passing a fine silk thread through it, and excise with a small pair of curved scissors or sharp scalpel as close to the inner canthus as possible. The slight hæmorrhage which follows is easily arrested by the application of a cold wet compress, and no bad sequelæ need be feared. In several cases which were kept under close observation for three or four years the animals did not in any way appear to be inconvenienced by the removal of their membranæ.[1]

Operation for Entropion and Trichiasis.—The term entropion is given to a condition in which the edges of the eyelids turn inwards; the term trichiasis is applied when the eyelashes turn inwards. The patient should be secured in the abdominal position and the head held firmly by an assistant. The hair is removed as closely as possible from the external surface of the eyelid, and the parts are then anæsthetised with cocaine, or the animal is placed under the influence of some general anæsthetic. An elliptical piece of the offending eyelid is then removed either with a pair of scissors or a scalpel, great care being taken to remove only the skin and not to injure the mucous membrane lining the lid. The wound is then sutured with fine silk or catgut, covered with iodoform (or orthoform) and collodion, and treated as an ordinary small surgical wound; when only a very small piece is taken out there is no absolute necessity for the insertion of the sutures. The only unfavourable sequelæ to be feared are when an ugly sore occurs as the result of continual rubbing or scratching,[2] or when too great an ellipse is made and the eyelid becomes a little everted; neither are, however, of anything more than minor importance. A second method of operating which is sometimes adopted consists in the application of a red hot needle or wire to the eyelid, the resulting contraction and scar causing the skin of the eyelid to be shortened. In cases of trichiasis it is sometimes necessary in addition to the above operation to pluck out the offending hairs by the roots; this is done with a pair of tightly closing forceps.

Ectropion.—This term is applied when the eyelids turn outwards, exposing the conjunctival mucous membrane; it is a much more

[1] "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 248, "Veterinarian," Vol. LXVII., p. 337.

[2] "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 247.

rare condition than entropion or trichiasis. It can be treated by the removal of a V-shaped piece of the eyelid, the incision being carried through the whole thickness of the lid, more of the mucous than the cutaneous being excised. The wound is then carefully sutured and treated antiseptically. Another method of treatment consists in the application of the galvanic cautery to the mucous surface in fine lines, a bone spatula being used to protect the eyeball itself; the object is to cause contraction of the mucous membrane by the formation of cicatricial tissue.

Operations on the Mouth, Pharynx, and Tongue.

Examination.—For a superficial examination, a good view can readily be obtained in canine patients by placing the finger and thumb of the right hand over the upper jaw in such a way as to press the loose, pendulous, skin of the upper lip inwards between the molar teeth; the left hand serves the lower jaw in a similar manner, and the two are then drawn gently apart so as to expose the interior.

The under surface of the lips can be examined in most cases without difficulty, but in an animal of uncertain temper it is always a wise precaution to first put on an ordinary tape muzzle. Where a prolonged examination is necessary it facilitates matters very much if the patient is placed on an operating table in the abdominal position and the services of some form of mouth speculum are called into requisition. The accompanying figures show different patterns, their method of use hardly needing any explanation.

FIG. 45.
Mouth speculum (Gray's pattern).

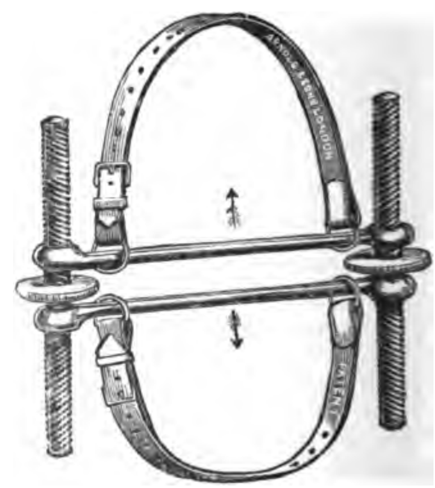


FIG. 46.
Mouth speculum (author's pattern

Gentle traction applied to two pieces of tape, one looped or tied round the upper jaw, and one round the lower, is also very effectual.

For the cat, if neither an operating table nor a set of hobbles is at hand, the best plan is to wrap the animal's body in a roller towel or strong cloth in such a way as to just leave the head exposed. The

mouth may then be opened in one of the ways mentioned above, but if attempting to open it with the fingers alone, the best plan is to secure the upper jaw firmly with one hand and depress the lower jaw by pressing the ball of the thumb on the top of the lower incisor teeth or by taking hold of the hair below the symphysis of the jaw.

Removal of Foreign Bodies.—The choice of an instrument for the purpose must depend somewhat upon the foreign body itself; the most common ones met with are bones and needles. A strong pair of curved throat forceps will do in the majority of cases, being applied when the mouth is held open. Sharp pieces of bone frequently get wedged across the mouth, each end becoming inserted between the molars, and occasionally the hollow shaft of a long bone becomes fixed longitudinally on the molars, causing the mouth to be propped open.

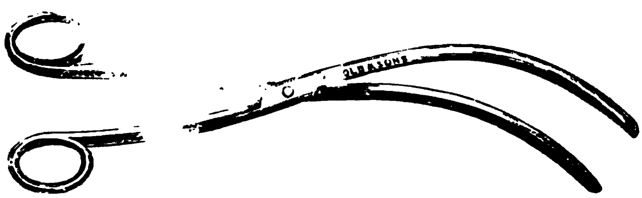


FIG. 47.
Throat forceps.

When removing a needle, care must always be taken to see in which direction the point has entered, as neglect of this precaution may lead to the breaking of the needle and unnecessary laceration of the mucous membrane.

Operation for Ranula.—By the aid of a speculum the mouth is fixed open, the tongue being drawn to one side or so arranged as to place the ranula in the most suitable situation for removal. The swollen sac is then punctured with a scalpel or sharp pair of scissors, the whole of the wall being dissected away as closely as possible. Great care must be exercised about this latter point, as if any portion is left the ranula will reappear after a short interval.[1]

Scarification of the Tongue.—This treatment is advisable in some cases of glossitis, and consists in scarifying the tongue freely but not deeply in a longitudinal direction in several places. The under or lateral surfaces are usually chosen, and the operation is performed with a small gum lancet or scalpel, the blade being protected from entering too deeply by being wrapped with cotton wool or tow.

Amputation of the Tongue or a Portion of it.—This operation is only undertaken as a last resource, as an animal which has lost a large piece of its tongue has difficulty both in eating and drinking. If the tip and edges are necrotic (a condition which was frequently seen during the epizootic which occurred amongst dogs during 1898 and 1899), these parts can be readily removed with a pair of scissors or sharp scalpel, being first seized with an ordinary pair of toothed or vulsellum forceps. If a large portion has to be removed chloroform should be administered. When the animal is deeply under its influence the tongue is drawn well forward, the mucous membrane and

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 358.

external muscles are snipped through with scissors, and a double thick silk ligature is passed through the centre of the remaining portion and tied off on either side; the parts below this are then excised. A small ecraseur, worked very slowly, answers the same purpose, or the ligature may be dispensed with and the lingual artery secured and twisted with forceps. Care must always be taken to keep the head in a horizontal or dependent position, in order that blood may not run down the larynx and trachea. After-treatment consists in the application of some antiseptic, such as solution of permanganate of potash, chinosol, or boric acid.

Operations on the Teeth.

Scaling and Cleaning.—Removal of tartar from the teeth is frequently necessary, both in the dog and cat, in order to keep the breath from becoming offensive, and in some instances, if neglected, tartar has been known to collect in such quantity as to prevent the animal from closing its mouth, and to cause a great deal of pain.

Scaling is performed by the aid of certain steel instruments specially designed for the purpose; there are numerous shapes for use in human dentistry, but, for all ordinary purposes, in canine practice two, or at most three, patterns will be found sufficient. The method

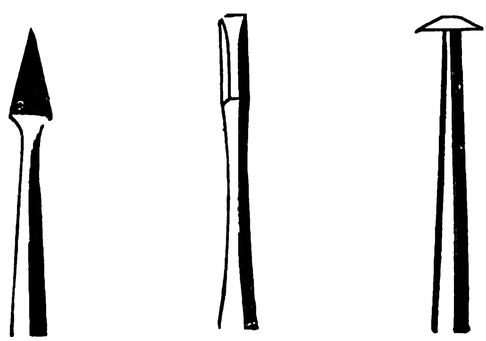


FIG. 48.
Scaling instruments of different patterns.

of application consists in securing the patient's mouth with a tape muzzle, obtaining the services of an assistant to hold the head, and removing the tartar around the teeth by the firm, steady application of one or other of the instruments; when the interior is affected a speculum must be used. As a rule the tartar shells off quite easily. The teeth are then cleansed by the application of some tooth powder or mouth wash on cotton wool or on an ordinary tooth-brush.

Extraction.—In extracting a tooth care must always be taken to get a firm grip as far up the fang as possible, pushing the points of the forceps well under the gum into the alveolar cavity. The offending organ is then loosened in its socket by a few lateral movements, and withdrawn by being pulled in a direction which is continuous with the fang or fangs. If pulled in a direction out of this straight line, unless the tooth is very loose, the crown is apt to be broken off. Canines are probably the most difficult to extract, and milk teeth

always require very delicate handling, or they will break off and a portion be left in the gum. A mouth speculum may or may not have to be used, depending upon the position and condition of the tooth to be extracted. When a general anæsthetic is administered, care must be taken that no blood or other foreign body finds its way down the trachea.

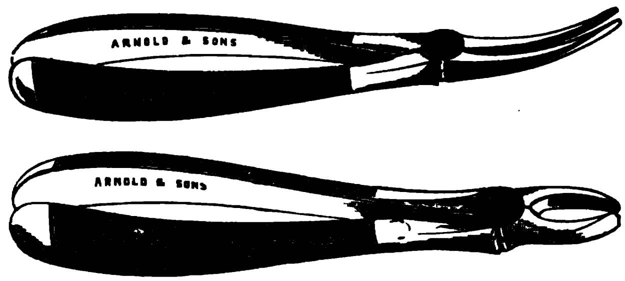


FIG. 49.
Showing different patterns of tooth forceps.

The insertion of false teeth has been successfully attempted by Mr Edward Mosely, L.D.S., in conjunction with the author,[1] the subject being an aged Schipperke whose teeth had almost all disappeared. The only remaining ones were four canines, the four carnassial molars, and a few very loose incisors. The latter were extracted, and impressions taken of the mouth. A false set of teeth was made and fitted in with springs and wires in the same way as in human dentistry. The animal tore the meat off a mutton chop very shortly after they had been put in, whereas before this it had taken nothing but liquid or finely cut food. The teeth were worn regularly for about eighteen months, when, unfortunately, one evening the animal was stolen and has not since been heard of by the owner.

Operations on the Throat.

Passing the Probang.—The probang is passed whenever a foreign body is suspected in the throat or œsophagus out of reach of the forceps. The mouth is fixed open with a speculum, whilst the probang, after being carefully lubricated and the stilette twisted a little so as to compress and stiffen the horsehair portion, is passed lightly and carefully down the œsophagus, care being taken that it does not enter the trachea and so cause asphyxia. If the foreign body is a large one, such as a piece of bone or gristle, gentle and continuous pressure must be applied; on no account must undue force be exerted, or laceration and rupture of the œsophagus may result as a sequel. If the obstruction is a small one it may either be forced onwards or withdrawn with the probang; needles and fish bones are often removed in this latter way, becoming fixed either in the sponge at the extremity or in the horsehair brush portion.

Before being withdrawn the handle of the stilette is pulled upwards out of its socket and, if thought necessary to stiffen it, slightly twisted; it is then taken out and examined, or it may be passed gently up and

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 362.

down the œsophagus for a few times. Probangs are made of different sizes, and especial care must be taken to use a sufficiently small one,

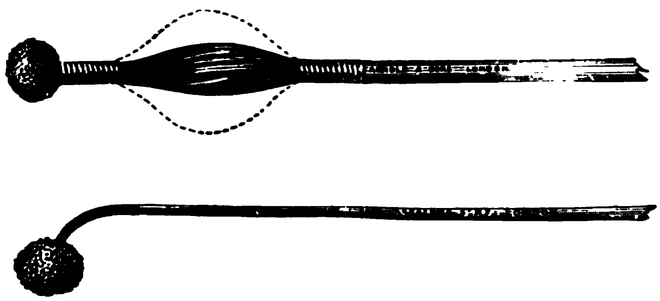


FIG. 50.
Showing two patterns of probang.

as otherwise the œsophagus is apt to become injured when violent pressure is put upon it. In inserting it, too, there is occasionally difficulty in guiding it past the larynx.

Œsophagotomy.—When a foreign body becomes so firmly lodged in the œsophagus that it cannot be moved by forceps or probang, the œsophagus must be incised. If this is not done ulceration may take place, or the foreign body may cause dilatation and form a pouch for itself, the result usually being great pain, emaciation, and, ultimately, death. The most common seats at which obstructions occur are just before the gullet passes into the thorax, and in the thoracic portion just before the œsophagus passes through the diaphragm. In the latter case it is sometimes necessary to perform laparo-gastrotomy, and, by the aid of a pair of thin forceps passed through the cardiac orifice of the stomach to reach the foreign body from behind. The operation upon the upper portion of the œsophagus is performed as follows.[1]

Place the patient in the dorsal position with the neck well extended so as to expose the throat; anæsthetise with some local anæsthetic, and incise the skin directly over the obstruction as near the centre as possible; apply pressure forceps to allay hæmorrhage, push aside any vessels in the vicinity, and expose the œsophagus. This organ is then incised longitudinally by a clean, bold cut, and the foreign body removed with forceps. At this stage vomiting sometimes occurs. The wound and surrounding parts are then thoroughly cleansed and disinfected, and the œsophagus is sutured through all the coats at the same time, the muscles and skin being then closed separately, and the whole covered with some antiseptic. The after-treatment consists in that usually applied to a wound, whilst particular attention is paid to diet; milk or soups containing small quantities of some non-irritant antiseptic such as boric acid or dilute chinosol may be given during the first three or four days, or rectal feeding may be resorted to entirely. When commencing again with solid food this should be cut up very small and given as slowly as possible. The bad sequelæ to be feared are tardiness of healing, the formation of an abscess, and ultimate formation of a stricture or fistula; but on the whole, if anti-

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 358.

septic measures are rigorously attended to, reports show that the results are very satisfactory.

Tracheotomy.—This operation is performed to relieve asphyxiating symptoms caused by acute laryngitis or pharyngitis, by the presence of some foreign body in the pharynx or larynx, and in some cases if dangerous symptoms become manifested during the administration of some general anæsthetic.

The prognosis is usually good, particularly in cases where the tube is only to be worn for a short time.

The patient is placed in the dorsal position with the head well thrown back and the skin of the neck held as tight as possible; after the usual antiseptic precautions an incision is made in the upper third

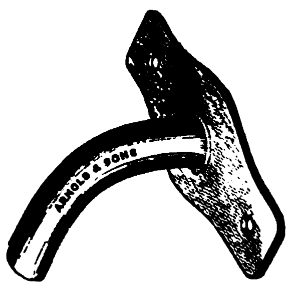


FIG. 51.
Tracheotomy tube.

of the neck about an inch below the larynx, at a spot where the trachea can be felt most superficially; the latter is picked up with a sharp curved hook or bent needle and thread, and an elliptical or circular piece excised to make a hole sufficiently large for the insertion of the tube. The tube is then placed in the trachea and fixed in position.

For temporary purposes a piece of bent glass tubing, held in position by tapes tied around the patient's neck, answers very well.

(*To be continued.*)

THE PATHOLOGY AND TREATMENT OF SPAVIN: A CRITICISM.

By JAMES MACQUEEN, F.R.C.V.S., Royal Veterinary College, London.

THE September (1898) issue of this Journal contains a translation of a masterly paper by Dr Eberlein, Berlin, on the pathology and treatment of spavin. The author devotes considerable space to a highly interesting abstract of the literature on the subject, but it may be noted that he quotes only two English authorities—Blaine (1805) and Smith (1893)—although Gibson, Coleman, Goodwin, Percivall, Dick, and Williams have recorded opinions which deserve some recognition. For his time, 1754, Gibson had a fairly satisfactory knowledge of spavin disease, and in respect of its treatment he anticipated much of current practice. Coleman stated that spavin originated in splint of

the hind leg, an opinion which evoked the criticism that his pathology was both defective and erroneous. Goodwin, veterinary surgeon to George IV., gave the first demonstration in this country of occult spavin, and held that the disease generally commences between the two cuneiform bones, extending later into their substance, which becomes carious, and that exostosis is an after effect. Percivall states that the seat of spavin is on the cuneiform and scaphoid bones, in the joints which they form with each other and with the metatarsus below and astragalus above, that the inflammation originates in the ligamentary and periosteal tissues, and that once exostosis has formed there seems hardly any limit to its extension. Dick considers that in bone spavin the ligaments and cartilages have probably been injured, and in consequence the bone and periosteum "inflame and throw out ossific matter." Williams regards spavin as an inflammation of the cuneiform and metatarsal bones induced either by concussion or by extension of inflammation of the interosseous ligaments, which are always implicated in the morbid process, and, further, that the ostitis originates in the cancellated tissue, and that consecutive exudation perverts the nutrition of the articular cartilage, which ulcerates and disappears.

Eberlein, after investigating the condition of 120 diseased hocks, concludes that in spavin the first change, as a rule, is an osteoporosis (rarefying ostitis) of the scaphoid, cuneiform, or metatarsal bone, which is very quickly followed by an osteo-sclerosis. Then the disease attacks the articular cartilage, inducing chondritis, and sooner or later anchylosis, and frequently the inflammatory process extends from the joint or direct from the bone to the periosteum, and there sets up periostitis with the formation of exostosis. In other words, that spavin disease originates always in the bone substance, and gradually extends from below upwards or from within outwards, that exostosis is a later effect of the extending ostitis, and that articular disease is the result of antecedent change in the bone. This view of the origin and extension of spavin is supported by numerous drawings of diseased tarsal bones; and if one were content to accept without question Eberlein's interpretation of the lesions, further inquiry should be unnecessary. But anyone who will take the trouble to carefully examine a few spavined hocks and to compare these with a few healthy hocks, will soon discover the need for caution in assuming that the nature of spavin disease has been settled. It should be stated, however, that if Eberlein has not succeeded in placing the pathology of spavin beyond dispute, he has earned high commendation by his zeal and industry in carrying out what must have been a laborious investigation.

Describing very minutely the macroscopical lesions revealed by vertical sections of spavined hocks, Eberlein finds spots or patches of an intense red colour (areas of ostitis), and the affected surface so soft as to yield to the pressure of the finger. These changes, he affirms, are observable in the earliest stages of the disease, "long before any alterations are visible in the articular cartilage or in the outer parts of the joint." This statement is pure speculation, unsupported by proof, and *primâ facie* it is insupportable, for no one may predict from a red patch in a tarsal bone the occurrence of articular disease or spavin exostosis. Eberlein seems to attach

unwarrantable importance to the colour of sections, which may be red or yellow and yet healthy. Much depends upon whether or not the horse has been bled at death. Softness of the coloured parts cannot be a constant feature of spavined hocks. Sections examined immediately after death do not yield anywhere to finger pressure, and even in the earliest stage of visible articular disease it is exceptional to find the substance of scaphoid, cuneiform, or metatarsal abnormally soft. The most frequent, but by no means constant, alteration of the interior of the affected bones is one of increased hardness and density, which may rightly be regarded as corresponding with the second stage of ostitis. Eberlein maintains that diagnosable spavin is always preceded by osteo-porosis. It may be so, though specimens showing this change are exceedingly difficult to find. But, granting provisionally that ostitis—rarefying and condensing—is the rule in spavin, how shall the exceptions be explained? Sections of typically spavined hocks are sometimes neither abnormally porous nor dense, and, except at the articular and free surfaces, remarkably like sections from healthy hocks.

Regarding the mode of extension of the disease from bone substance to articular surface or to the periphery, Eberlein states that the rarefying process extends indifferently in all directions, and involves the surrounding parts; that it meets with resistance from the articular cartilage beneath which it spreads—interfering with nutrition and leading eventually to destruction of the cartilage. Undoubtedly when ostitis extends in the manner just indicated the cartilage will suffer, and so far the process of extension and destruction is quite feasible. But something more is required to explain the almost constant occurrence at one place of the earliest articular lesion. Specimens seem to prove that the resistance of the cartilage to destruction, however induced, is less towards the inner articular margin of scaphoid and cuneiform than elsewhere, and it may be asked why this should be so.

It is obvious that the destructive process in the cartilage must start somewhere, although an ostitis which extends indifferently in all directions hardly accounts for the almost invariable position of the earliest change. If the arthritic disease always resulted in complete disappearance of the cartilage, the situation or extent of the first breach of surface would have less importance, but the very limited articular lesion of many chronic cases furnishes a difficulty in spavin disease which no published theory of extension seems able to surmount. Another peculiarity not yet explained is the escape of the periosteum in occult spavin. Why the extending ostitis should not always invade the periosteum, which is in vascular communication with the area of inflammation, Eberlein does not venture to state, but he suggests that when the disease arises in the metatarsus it always extends upwards. Why not sometimes downwards? There is nothing in the structure of the large metatarsal bone to prevent distal extension of the rarefying process.

Ostitis is not the simplest disease, and shreds or microscopic sections of decalcified bone do not give unmistakable information. Observation, perhaps, has been at fault. The boundaries of an inflamed area can generally be ascertained, but the direction of extension within the area is not always ascertainable, especially in bone

spavin. A probable explanation of most cases is, that the ostitis is superficial and reactionary, and that it constitutes an attempt to repair the effect of damage sustained at the articular or periosteal surface.

Objection may be taken to the statement that the earliest changes in the articular surface almost always occur 2-3 mm. within the joint margin. In many cases the margin itself first shows disease, the remainder of the cartilage being free from spot. Bearing upon this point, Eberlein makes a discovery which unfortunately cannot be confirmed. He finds that the closing or contact edge of the smaller tarsal joints is from 2-3 mm. within the articular margin, and to this "striking fact" he attributes the position of the first erosion of the cartilage. And further, that the contact here resembles that which obtains in the cardiac valves. But in hocks—healthy or diseased—the articular edges respond to one another with remarkable exactitude —a mere seam indicating the line of closure—which is certainly very unlike that of the cardiac valves.

Of the other changes in spavined hocks little need be said. They vary considerably. Eberlein describes punctiform projections (calcified points) as common features of the articular disease, but he does not mention cribriform erosion. Holes with smooth rounded margins usually occur and very early in the facets, and projections or spiculæ when present are generally confined to the insertion surfaces.

Anchylosis in many cases is limited, cartilage being retained on part of the facets. Fusion of scaphoid and cuneiform without a trace of the articular cleft occurs now and then, and most frequently in cases complicated by exostosis. Anchylosis is oftener peripheral than central, although at first view union may appear central owing to ossification of the interosseous ligaments. On breaking an anchylosed scapho-cuneiform joint, the articular surfaces may be found eroded yet free; the insertion surface of one side may show bony projections, and the other excavations extending into or threatening invasion of the adjacent facet. In a very ingenious description of the process of anchylosis, Eberlein states that the erosion of the cartilage develops at corresponding points of the opposed surfaces, but he does not very clearly explain how this happens. Proliferating granulations growing from the bone first eroded into the opposite surface may effect a correspondence of prominences and excavations, but the explanation hardly applies when both surfaces are similarly pitted or excavated, or when two bones, as scaphoid and cuneiform, simultaneously affected with ostitis exhibit articular lesions which resemble each other.

Regarding the nature of the joint affection, Eberlein rightly differs from those who hold that it is akin to the chronic deforming arthritis of the human subject, which attacks the larger and less frequently the smaller articulations. In man loose bodies occur within the affected joints, and the bones undergo deformation and shortening, but anchylosis has not been observed. In spavin arthritis the process, however induced, leads to anchylosis, and further investigation will probably prove that Schrader was right in defining spavin as "a peculiar independent joint disease."

The etiology of spavin is still obscure. Bruising of the smaller bones has been given as the initial change, and over-exertion of the hock in kicking, jumping, slipping, or in starting heavy loads as

the chief external cause. Experience teaches that spavin disease or lameness frequently follows wrenching or other similar injury during hock extension, but it has not been determined that accident of the kind indicated inflicts more damage to bone tissue than to the other structures of the hock. In the action of joints the bones cannot be considered independently of the cartilage, and it is not improbable that both cartilage and bone are injured at the same time. In the compression of the tarsal bones which is believed to result in spavin the first effect of the pressure should be felt by the cartilage, which will not withstand repeated squeezing unchanged. It has been ascertained that simple incised wounds of cartilage can be repaired, and that bruising leads to erosion or to transformation of the cartilage into bone. The progress of the arthritic disease is remarkably slow, and in many cases the horse is not lame and spavin may not have been suspected.

The *causa interna* is still more difficult to understand, but the custom has been to ascribe cases of spavin to inherent weakness of the hock. Eberlein pretends to recognise in the complicated construction of normally built hocks a special predisposition to mechanical injury, though he does not indicate what he means by a normally built hock. All hocks may be said to be complicated in construction. Hocks of every conformation may be found spavined, and, although small or weak, flat or thin hocks are more often affected, satisfactory explanation of the cause of spavin disease must be sought in something else than mere shape. It is true that horses with long bodies, heavy quarters, and light legs, whether cow-hocked, straight or bandy legged, are sometimes affected, but horses with short bodies, light quarters, and strong legs, and even cattle—old cows in particular—are frequently spavined. If horses of high courage and free action often suffer, horses that are sluggish or exceptionally quiet and without attractive action do not escape. Observation suggests that the class of work has an important share in the causation of hock lameness, and that 'bus and other horses, doing work that necessitates incessant stopping and starting on roadways which give only an indifferent foothold, furnish a large proportion of cases of spavin.

The almost invariable occurrence of the disease at the inner side of the hock has been variously explained. One view is that the inner parts carry more of the weight than the outer; and another that the screw-like form of the articular ridges of the astragalus serves to conduct the pressure during hock extension more to the inner side. The value of these observations Eberlein, forgetting Goodsir, credits to Hering and Prosch. But careful examination of the tarsal bones, with regard to position, prominence, and curvature of the articular facets, should assist in arriving at the probable cause of the incidence of spavin at the inner part of the joint and of the situation of the usual articular lesion. In normal scaphoid and cuneiform bones the cancellated tissue exists chiefly within the ligament insertion surface, where compact bone is thinnest and contact is less intimate than at the facets. The earliest visible articular lesion usually appears on the antero-internal part, where compact bone is thickest, and, presumably, where resistance is strongest. If Eberlein is right the causal bruising affects the strongest part, and the resulting rarefying ostitis extends through dense bone and not in the direction of least

resistance. If ostitis always initiates the disease, the insertion surfaces should more frequently show its effects. But evidently the ostitis, like the arthritis, is peculiar, and it is not easy to demonstrate the different stages of either process. A reasonable solution of the difficulty may be found by supposing that both arthritis and ostitis begin simultaneously, and that sometimes the articular disease is more active and extensive than the ostitis.

In explaining the extension of chronic joint disease it is always safe to assume the existence at one time or another of rarefying or condensing ostitis, which, as a superficial process, is a constant accompaniment of chronic ossifying periostitis. But it must be said that neither the excentric nor the concentric theory of extension will satisfactorily account for all cases of spavin. Specimens prove that there is more than one way, and, indeed, it would not be difficult to find hocks to illustrate and more or less prove four of the five recognised theories of the origin and extension of spavin disease.

To meet the latest theory of the genesis of spavin it will be necessary to revise the symptomatology, and to consider the possible existence of, (1) spavin disease without either lameness or exostosis, (2) spavin with exostosis but without lameness, (3) spavin without exostosis but accompanied by lameness, and (4) spavin with both lameness and exostosis. The first variety may be distinguished as Eberlein's spavin, in which ostitis of one or another of the tarsal bones occurs long before visible alteration of the articular cartilage or of the outer parts of the joint. No symptoms are exhibited in the living animal. This sort of spavin is distinctly occult, and altogether outside ordinary practice. The second is common enough, and the third constitutes a variety of tarsal disease which, in most cases, is more difficult to discover than any other. The fourth usually presents no special difficulty in diagnosis.

The symptoms described by Eberlein include all those usually accepted and one or two that have little value. The spavin test is not reliable even in cases where examination of the limb in other ways yields negative information. To distinguish a coarse hock from spavin exostosis is especially difficult, but veterinary surgeons who take a lenient view of enlarged hocks—which are only suspicious because of coarseness—seldom have occasion to regret their opinion. Diagnosis by measuring suspected hocks is unlikely to meet with approbation outside veterinary schools, and the employment of the Röntgen rays as an aid to diagnosis, or to lessen difficulties which too often are much exaggerated, will have to wait further improvement in the application of the apparatus. With Eberlein the prognosis of spavin is always uncertain and the presence of exostosis gives a permanent predisposition to lameness. This is an extreme view but it is undoubtedly safe, for the reason that no one can say how long a horse, bought sound in action, will continue at work free of lameness. Observation, however, goes to show that horses with spavined hocks may work for years without falling lame; indeed one of the several enigmas of spavin is the continuance of unexceptionable action. But when lameness exists only a rash mind will undertake to fix the date of its disappearance. Statistics of the curability of spavin lameness are of trifling value; their accuracy is only problematical, as it must be so long as diagnosis is uncertain.

Eberlein seems to think that the lameness engenders other diseases in the affected leg, and cites ringbone, inflammation and contraction of the flexor tendons, and disease of the stifle joint, as sometimes following spavin. In attributing these diseases to the existence of spavin lameness he goes beyond probability or draws from a unique experience. If there is any truth in the compression theory of the causation of spavin, ringbone and strained flexor tendons are more likely to precede than follow spavin disease, and this can be affirmed of ringbone.

The natural tendency in spavin is towards consolidation of the affected bones, and the value of treatment mainly depends on whether it promotes or retards anchylosis. For nearly a century and a half the treatment of spavin has undergone little change except in the method of application, which has been modified and perhaps improved. Line and puncture firing, caustics, setons, tenotomy, periosteotomy, slitting the cunean bursa, and even neurectomy—the last resort of the baffled surgeon—have all been practised. With one exception the least reasonable of these operations is cunean tenotomy, which seldom confers benefit, because in the majority of cases the tendon passes above the enlargement. Periosteotomy, first practised by Sewell (1835), is a bolder operation, and one that is indicated when exostosis is very large. Setons are still useful, and, if not quite so beneficial as periosteotomy, they are far less risky. Piercing the exostosis with a sharp fleam-headed iron was practised by Gibson, Coleman, and Turner before the introduction of the iron with conical head or needle-shaped point. Eberlein strongly recommends perforating firing. He fired 102 horses and in many effected a cure—which must be extremely gratifying to those who puncture exostoses. It is to be regretted that Eberlein is silent as to the treatment of lameness due to occult spavin, of which he must have large experience. At one time occult cases were treated by repeatedly blistering the hock and resting the horse in loose-box or straw yard for six months; but in this neurotic age owners too often lack patience and refuse to submit their lame horses to treatment that is only expectant. On humane grounds succedaneous rest needs no apology, but it cannot be defended as promoting anchylosis, which should be the aim of the treatment of spavin.

EXPERIMENTAL TUBERCULOSIS IN THE ASS AND THE EFFECT OF TUBERCULIN.

By STEWART STOCKMAN, Professor of Pathology, Royal Dick Veterinary College, Edinburgh.

FOR a time the existence of tuberculosis in the horse tribe was denied, and the denial was based both on clinical and experimental observations. Later clinical experience, however, has shown that the disease in the horse is by no means rare in this country at least, and the more recent experiments prove that the horse can be infected artificially with tuberculosis, although positive results seem to depend on certain provisions. Some of these conditions are evident, others call for further investigation. The experiments which I am about to describe seem

to me to throw some light on the latter, as well as on those cases in which the result of the tuberculin test is considered doubtful. Long after the existence of tuberculosis in the horse was admitted, the supposed immunity of the ass was still maintained. So far as I am aware, only one case of natural tuberculosis in the ass has been recorded and that by Blanc. One or two cases have been reported in the mule. Few as these observations are, they render untenable the opinion that the ass and mule are absolutely immune from tuberculosis; indeed, I think that the high degree of natural immunity ascribed to certain species in comparison with others has been somewhat exaggerated. It is based largely on the result of laboratory experiments, which are often misleading, and on outside observations which are not always quite comparable. Chauveau was the first to experiment on the ass with tuberculous material. He showed that, if tuberculous material from man or the ox were injected intravenously, tubercles appeared in the lung, but, in order to see them, the ass had to be killed twenty-five to thirty days after inoculation, because the animals recovered. Nocard[1] in 1888 inoculated two asses with tuberculous material rich in bacilli from a horse attacked with abdominal tuberculosis. One of the animals died ten days later from some septic trouble. No typically tuberculous lesions were found. The other wasted to a shadow and was killed about twenty-five days after inoculation. No tubercles were found at the autopsy, and it was concluded that death was due to some kind of intoxication.

Jöhne obtained tubercles in the lungs of the ass by intravenously inoculating tuberculous material, but his animals did not die; he had to slaughter them to see the nodules.

With a view to study the lesions in animals which are said to possess a high degree of immunity, and to compare them with those found in susceptible animals, I performed the following experiments, with the usual antiseptic precautions.

Experiment I.—Ass A. Four years old, entire.

The animal did not react to tuberculin and was healthy in all respects.

On the 27th January the animal was inoculated into the jugular vein with an ordinary sized platinum wire loopful of tubercle bacilli from an actively growing glycerine agar culture of five weeks standing. The bacilli were well rubbed up in a sterile mortar with sterile broth. The annexed Charts I. and II. show the temperature reaction after inoculation, and the results of the tuberculin test applied three times at intervals of from seventeen to twenty days.

Apart from the temperature reaction of 2·6° F., the animal showed no signs of ill health after inoculation. It will be seen that at the first test with tuberculin, applied nineteen days after the bacilli were injected —when the temperature had fallen again to normal—the temperature reaction was equal to 3·6° F. It may be as well to mention here that the rise in temperature was in all cases calculated from the highest point on the chart of the day preceding the test. Under ordinary circumstances the first reaction would count as a positive result I must confess that I fully expected the ass to die of tuberculosis, but on the contrary he continued to thrive. The second test gave a reaction equal only to 1·6° F.; in fact, the result under

[1] Comptes Rendus Congrès pour l'étude de la Tuberculose.

CHART I.—DONKEY A.

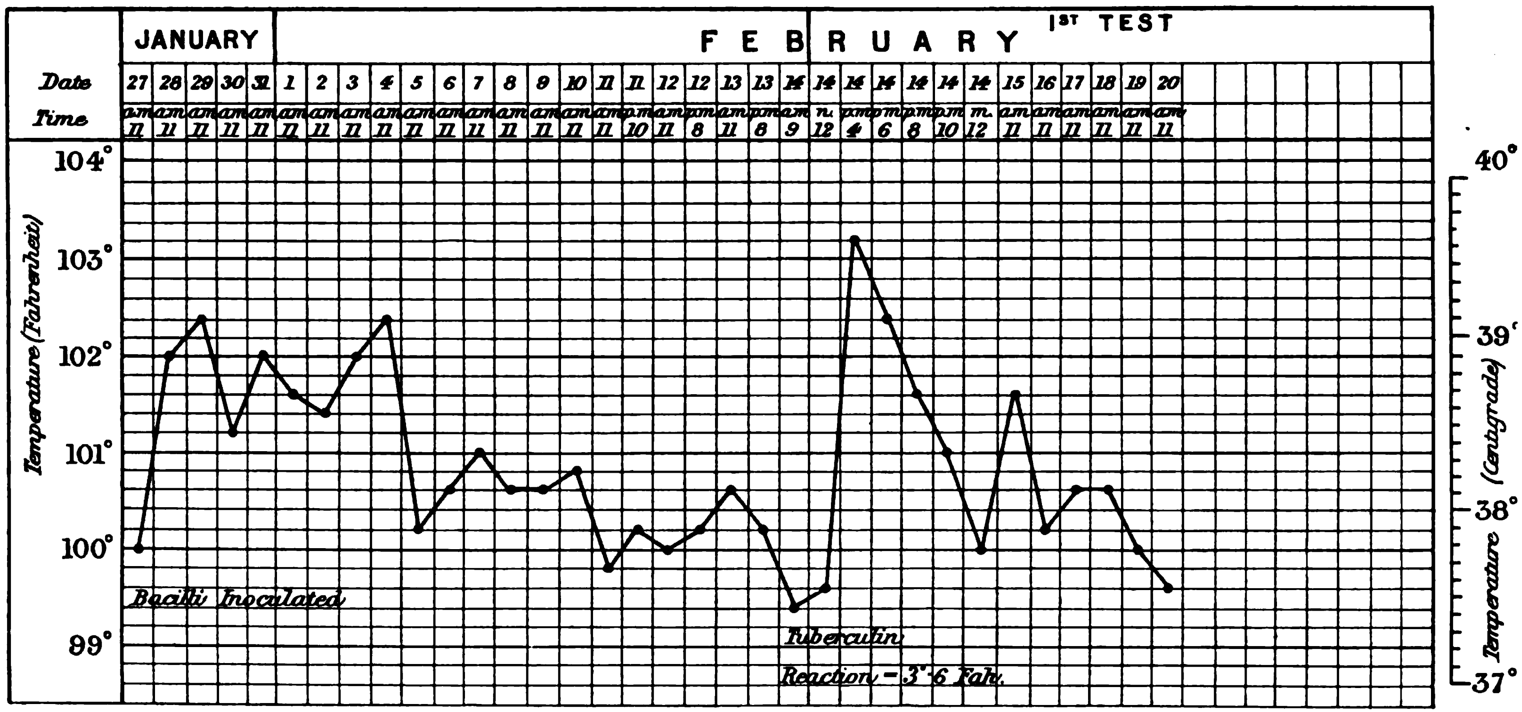
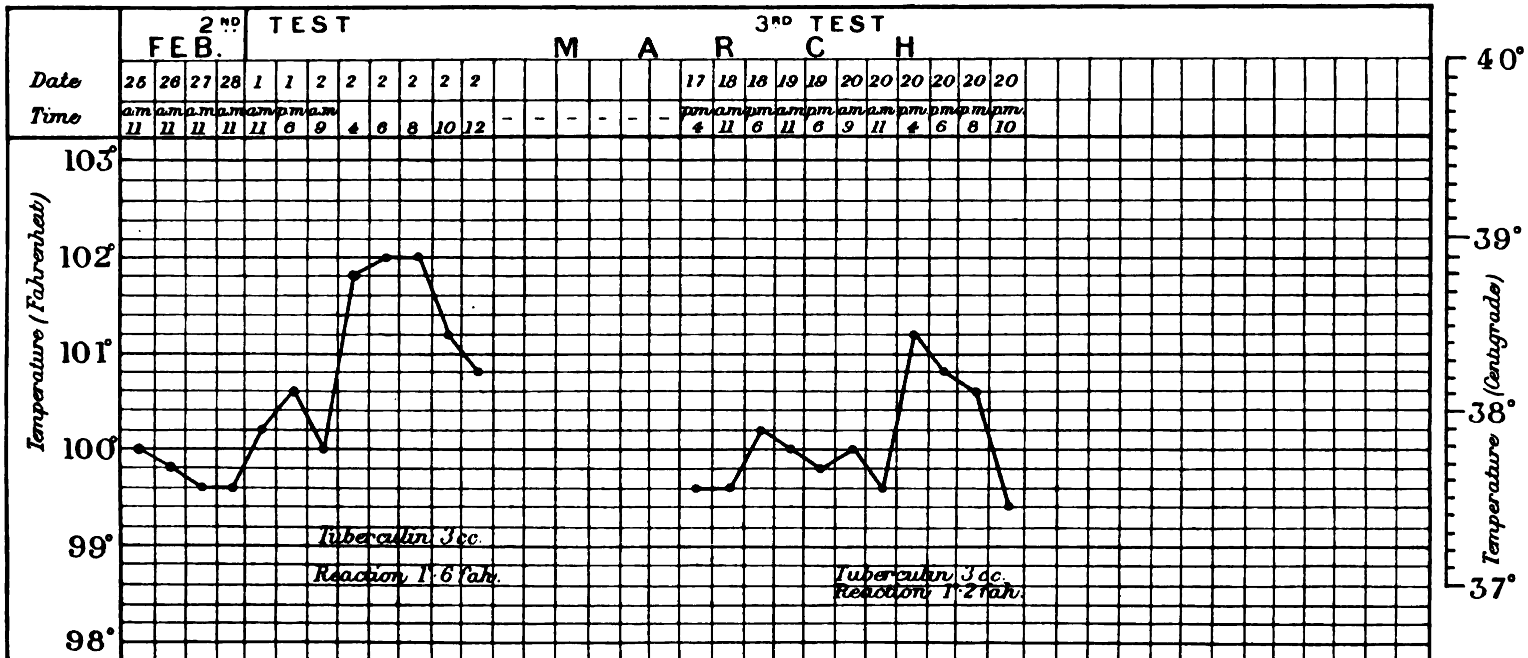


CHART II.—DONKEY A.



ordinary circumstances would have been considered negative. The third test gave the same result as the second. The animal continued in perfect health until the middle of April, when he was castrated and sold. He is still perfectly healthy.

Experiment II.—She ass. Two years old, healthy in all respects.

On the 2nd February this animal received into her jugular vein a similar quantity of the culture used in Experiment I. The bacilli were previously rubbed up in a mortar with sterile broth.

Chart III. shows the temperature reaction after inoculation, and the results of the tuberculin test twice applied, with an interval of sixteen days.

The bacilli here caused a rise of temperature equal to 2·8° F. The results of the tuberculin test were similar to those in Experiment I.

In order to see if any lesion were present, this donkey was killed on the 8th March. Up to that time she had remained in good health and had put on flesh.

Autopsy.—The lungs showed about two dozen macroscopic nodules under the pleura and in the lung substance. These nodules varied in size from a pin's head to a small pea. They were yellowish in colour, firm and well defined, and showed no signs of caseous degeneration. They closely resembled the nodules that I have described in my experiments with tubercle bacilli killed by heat (*Journal of Comparative Pathology and Therapeutics*, 1898). They were also very like the large pseudo-tuberculous nodules of the sheep. Cover-glass preparations made from the juice of the nodules showed tubercle bacilli. Sections of the lung nodules examined under the microscope showed the ordinary tuberculous elements—giant cells, epithelioid cells, and leucocytes. Bacilli were numerously present in some of the nodules. As in the case of nodules produced by dead tubercle bacilli, there was a tendency towards fibrous formation at the periphery of the larger ones. The sections also showed a number of nodules too small to be visible to the naked eye. The bronchial and mediastinal glands were normal to the naked eye and to the microscope. The liver, spleen, and kidneys were normal to the naked eye. They have not yet been examined microscopically.

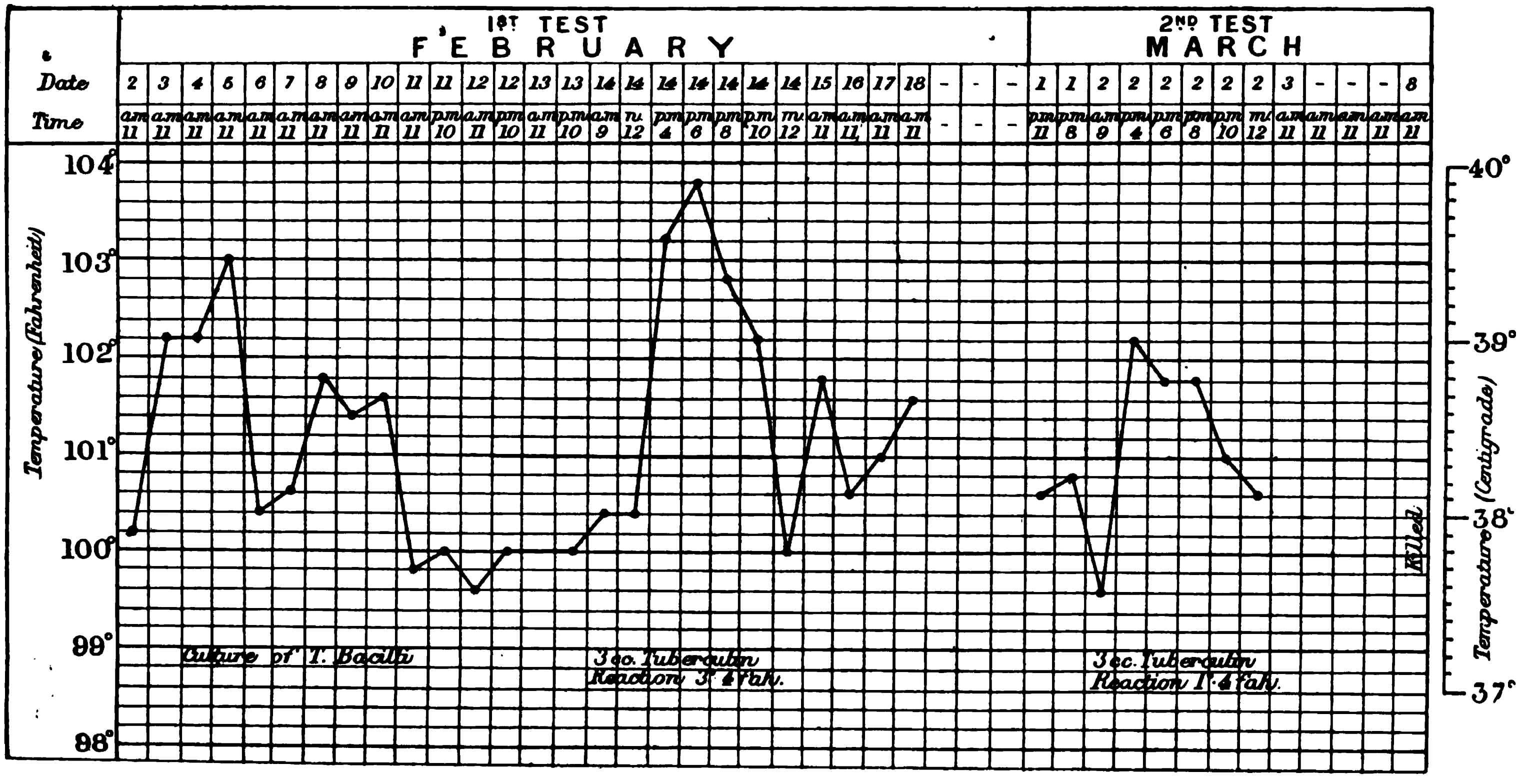
To test the virulence of the bacilli from the nodules, and to see if they were present in the glands, three guinea-pigs, I., II., and III., were inoculated with preparations of the tissue juices.

Guinea-pigs I. and II. received a broth emulsion made from three lung nodules, which had been excised with sterilised instruments and pounded in a sterile mortar. The emulsion was fairly rich in bacilli. Guinea-pig I. received about 3 cc. of the mixture into the left thigh, II. about 6 cc. into the abdomen. Both were examined after a sufficiently long interval had elapsed for the development of lesions, but in neither was there a speck of tubercle to be found. Guinea-pig III. was inoculated into the abdomen with a mixture of broth and gland juice from the mediastinal gland. Cover-glass preparations and sections (made afterwards) of this gland showed no bacilli. The result was negative; no lesions were found on *post-mortem* examination.

Experiment III.—Mule, mare. Aged, lame, tricuspid murmur, but otherwise healthy.

On the 2nd February she received into her jugular vein a similar

CHART III.—DONKEY B.



quantity of the culture used in Experiment II., rubbed up in sterile broth.

Chart IV. shows the temperature reaction after the inoculation, and the results of the tuberculin test twice applied, with an interval of eighteen days.

It will be observed that the temperature in this case rose 3·6° F. Possibly the number of bacilli injected was greater, but I ought to mention that the mule was of a very nervous temperament, and disposed to kick when approached.

The first reaction to tuberculin was very decided—4·2° F. The second reaction was abortive—1·6° F.—and similar to that obtained in the other two cases. The mule preserved all the appearances of health until a month after the last test. She was then killed for the dissecting room. I was unable to make a complete *post-mortem* examination for fear of spoiling the organs for dissection, but no distinct nodules were found in the lungs. They had apparently disappeared.

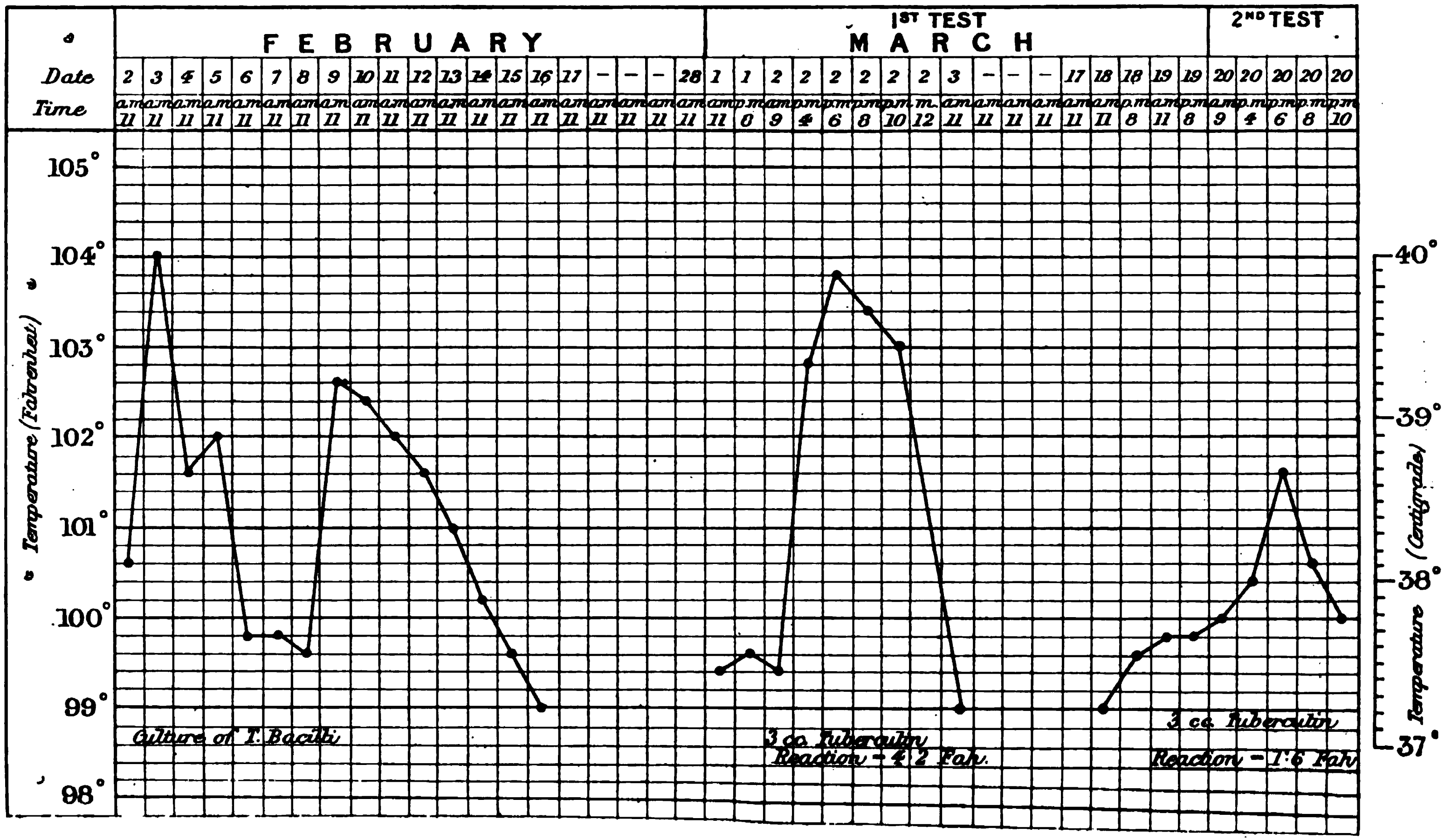
At first sight it would appear from these experiments that the donkey possesses a high degree of resistance to tuberculosis. They do not show, however, that the degree is greater than that possessed by other species under similar conditions; and it is to be noted that the guinea-pigs—animals in the first rank of susceptibility—did not show any lesions whatever when inoculated with material from the lung nodules of Ass B. It may be said, however, that the bacilli inoculated to the guinea-pigs had been killed in the tissues of the ass. That explanation is, of course, possible, but it cannot be accepted on such slender evidence. I think a more likely explanation is that the bacilli of the culture employed, although growing strongly, had to a large extent lost their pathogenic power, and so fell an easier prey to the phagocytes. The pathogenic power of a microbe depends to a great extent on its ability to gain a footing in the body, and this power varies considerably in specimens obtained from different lesions, but still more in those from artificial cultures.

It must not be forgotten, however, that the prolonged existence of the tubercle bacillus in the bodies of certain animal species may have an important influence on its pathogenic effects on others. Fowls are difficult to inoculate experimentally with human tuberculosis, and mammals, with the exception of the horse (Nocard), are extremely resistant to avian tubercle. The beautiful experiments of Nocard,[1] however, show how the former may be converted into the latter by habituating the bacillus to the new medium.

The tubercle bacilli most abundantly disseminated amongst us are those which have come from human beings or oxen. The practical test of susceptibility, performed in the laboratory, should be based on the facility with which an animal can be infected with human or bovine tuberculous material. As has already been mentioned, however, the virulence of the bacilli varies even in tuberculous animals of the same species, so that a considerable number of experiments would have to be performed before a definite opinion could be arrived at. So far as the ass is concerned, the experiments are too

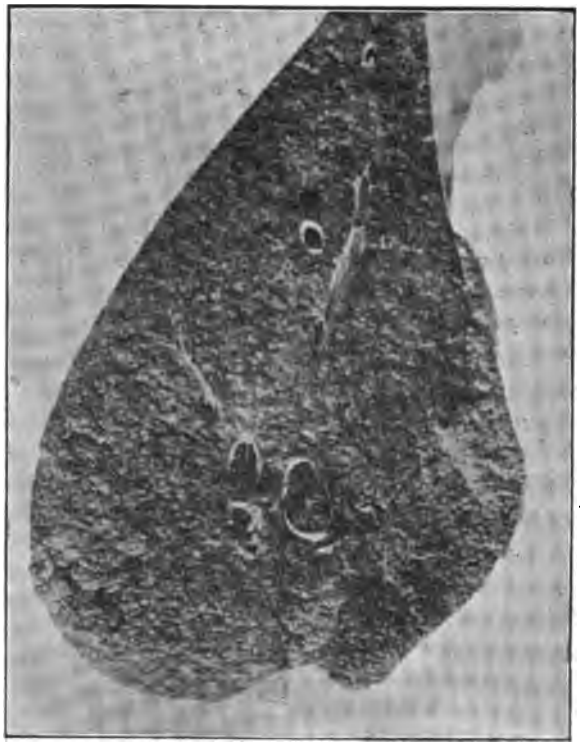
[1] Sur les relations qui existent entre la tuberculose humaine et la tuberculose aviaire. —"Annales de l'Institut Pasteur," September 1898.

CHART IV.—MULE.



few to justify the conclusion that they are specially refractory to tuberculosis. All we can say is, that asses seldom naturally contract tuberculosis, noting the while, that they are not often exposed to the infection. What the result of keeping she asses for the production of milk would be, if they were put under the same conditions as our dairy cows have been, I do not think it would be difficult to predict. One would have the great advantage, however, of being able to start with clean herds. That the ass is not refractory to tuberculosis of equine origin is proved by Experiment IV.

Experiment IV.—On the 5th April the spleen and lungs of a horse dead of tuberculosis were sent to my laboratory for an opinion on



Lung of Ass C.

the nature of the disease. The spleen contained about half-a-dozen chronic nodules in its substance, and the lungs showed a miliary lesion. One of the spleen nodules about the size of a pea was excised with all the usual precautions, and bruised in a sterilised mortar with about 10 cc. of sterile broth. The mixture was then filtered through sterilised muslin, and 5 cc. of the liquid were on the same day (5th April) injected into the jugular vein of an ass. Cover-glass preparations made from the fluid showed a fair number of bacilli, but they were not anything like so numerous as in the case of the material used in Experiments I., II., and III. They were undoubtedly virulent, however, for they had killed the horse. This Ass C. was

a female, one year old and healthy. On the 5th April her temperature was 99·6° F. Contrary to what occurred in I., II., and III., the temperature did not rise after the inoculation until a period of incubation had elapsed, possibly because the number of bacilli injected was much smaller in IV.

Up to the 20th April the daily temperature of C. fluctuated between 99·6° and 100° F.

Chart V. shows the reaction to tuberculin applied fifteen days after inoculation.

It will be seen that the result of the test was positive—4·6° F.—and that after the test the temperature was always above the normal until the day before death. On the 23rd April a subcutaneous swelling was noticed at the seat of inoculation, and by the 1st of May it had attained the size of a bantam's egg. The swelling was hard and painless. It did not burst, but gradually diminished in size from the 1st May. It was, of course, due to some bacilli which had escaped into the subdermal tissues. From the 1st of May the respiration became hurried, and the animal emaciated rapidly. She died on the 21st May, about seven weeks after inoculation.

Autopsy.—The lungs were simply crammed with firm miliary tubercles of a greyish-white colour (*see* Fig.) The glands were slightly swollen and congested, but showed no tubercles. Sections of the lungs examined under the microscope showed a multitude of tubercles containing bacilli. Giant's cells were not numerous, and there were no caseous centres.

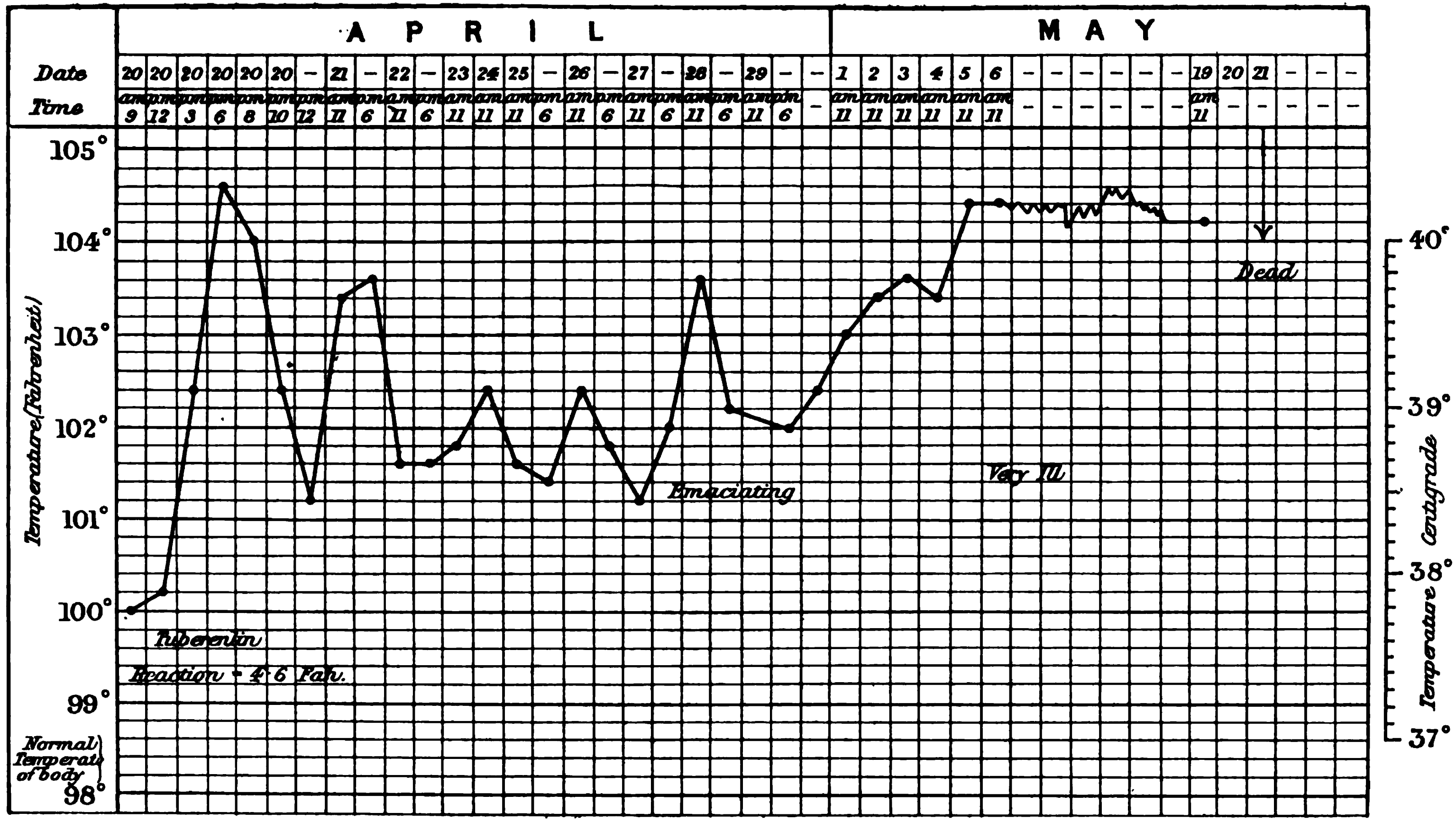
The other organs were healthy to the naked eye. The tumour at the seat of inoculation contained caseous material in which tubercle bacilli were numerous.

A rabbit—the only animal to hand at the time—was inoculated into the thigh with some of the caseous material from the tumour, but as this animal died five days afterwards from another cause the experiment failed.[1] The failure of the latter experiment, however, is not of great importance, as the donkey had undoubtedly died of tuberculosis.

The appearance and disappearance of the lesions call for some explanation. When tubercle bacilli come to rest in an organ, they excite a well-known reaction in the tissues, which need not be discussed here in detail. The result of this reaction is the lesion. The number of bacilli necessary to produce a distinct lesion is a debatable question, but it will almost certainly vary with the degree of virulence possessed by this or that specimen. With dead bacilli several are certainly necessary in one part before a distinct lesion is produced. Straus and Gamaleia,[2] using a small number of dead bacilli, showed that if the microbes were well mixed and distributed through broth no lesions were produced in the rabbit. My own experiments[3] on the dog show that when the dead bacilli are few the lesion does not go beyond the microscopic stage. When the bacilli introduced into the tissues are virulent enough to reproduce themselves there, there is very soon a sufficient number present to

[1] This rabbit was affected with the disease known in Scotland as "the sniffles."
[2] "Arch. de Med. Exp. et. d'Anat. Path.," 1891.
[3] Stockman. Brit. Med. Journal," Aug. 1898.

CHART V.—DONKEY C.



give rise to a fully formed tubercle consisting of epithelioid cells, giant cells, and leucocytes. This tubercle is looked upon as the evidence of a struggle taking place between the cells and the microbes. If the cells are victorious the microbes are overcome, no fresh lesions are produced by them, and those already formed disappear in time along with the bacilli. Every one who has worked with tubercle bacilli, either with cultures or preparations from lesions, knows how the microbes tend to stick together and form masses. It is well-nigh impossible to separate these clumps by ordinary trituration, and it is to them that the larger tubercles, the ones that persist longest in the case of dead or attenuated bacilli, are due.

If the bacilli are inactive and little numerous the lesions will disappear in a short time. In Experiment I. with dead tubercle bacilli [1] a bitch received into her jugular vein 50 cc. of a two months' glycerine broth culture of the tubercle bacillus killed by exposing it for half-an-hour to a temperature of 110° C. This animal received what might be termed a colossal dose of bacilli, and yet at the autopsy performed four months afterwards not a single tubercle was found in the lungs, only a number of blotches on the pleura. In Dog Ia. which was killed twenty days after dead bacilli had been injected, the tubercles in the lungs were numerous. The removal of inactive bacilli and the disappearance of the lesions, then, is only a question of time.

The Tuberculin Test.

Nobody will now deny that the tuberculin test is the best method of diagnosing tuberculosis, but it is not infallible. The results of the test when applied to the larger animals whose bodies contain dead or attenuated tubercle bacilli seem to me to afford an explanation of some of the fallibilities at least.

In Experiment II.[2] (Horse), in which a large number of dead bacilli were injected into the jugular vein, the tuberculin test applied three weeks afterwards gave a reaction = 3° F.

In another experiment on a horse, the details of which are as yet unpublished, a small number of dead bacilli were injected, and the result of the tuberculin test applied one month afterwards gave a negative result. In the experiments with attenuated bacilli, which have been described in this paper, the results of the first tests were always positive, the second and third gave reactions that would have been looked upon as doubtful or disregarded altogether.

Before attempting to explain these results it will be as well to enquire into the ideas held regarding the *modus operandi* of tuberculin. On the larger animals which are free from tuberculosis, injections of large doses of tuberculin have little effect. This result has been obtained by a large number of experimenters, and I think everybody agrees that the soluble products of the tubercle bacillus in culture have little effect on healthy animals. Without giving in detail the different quantities of tuberculin used by the many workers at this subject, I would simply say that I have myself given to a healthy dog 10 cc.-30 cc. of tuberculin without producing any effect. It cannot be admitted then that the reaction produced in tuberculous animals is due simply to the small amount of

[1] Stockman. "Brit. Med. Journal," Aug. 1898.
[2] Stockman. "Journal of Comparative Pathology and Therapeutics," June 1898.

toxin introduced in addition to that already existing in the body. Although the products which are soluble in the ordinary fluid media, in water, or in alkaline solutions, have almost no effect on healthy animals, a comparatively small number of dead or living tubercle bacilli are capable of raising the temperature several degrees after some hours.

Apparently the pyrogenic substance is contained in the bodies of the bacilli and is extracted from them in the tissues. Probably, as Prudden and Hodenpyle[1] suggested, the bacilli are broken up, as it were, by the phagocytes, and the fever-producing substance is in this way set free. When a dose of tuberculin is injected to a tuberculous animal, a hyperæmic condition occurs in the neighbourhood of the lesions and the phagocytes accumulate. The result is that the liberation of this pyrogenic material is greatly accelerated, hence the reaction. If the bacilli are dead or nearly so, as in the case of some of the above-mentioned experiments, the first reaction deprives them of the greater part of their pyrogenic toxin, and there is not a sufficient quantity left to produce a decided rise in temperature at the second test. When the bacilli in the animal's body are living and active a new crop is soon produced and a second reaction is obtained. It is possible that in some of the cases in which no reaction has been obtained, although tuberculous lesions were found at the autopsy, the bacilli have already been deprived of their toxin by the tissue cells.[2]

I am now making another series of experiments bearing on this subject, but they are not yet sufficiently far advanced to admit of publication.

In conclusion, I wish to express my thanks to two members of my class, Mr Littler and Mr Boyd, for the great assistance they have given me in the course of these experiments.

THE OCCURRENCE OF CANCER IN THE LOWER ANIMALS.[3]

By J. M'FADYEAN, M.B., B.Sc., Principal of the Royal Veterinary College, London.

EVIDENCE bearing upon the etiology of cancer among human beings obviously ought to include the known facts regarding the occurrence of cancer in the lower animals. In the following pages an attempt will be made to present these facts in outline.

In the first place, it is obviously necessary to define, with as much precision as possible, what varieties of morbid growths are in this article included under the term "cancer." The necessity for this arises from the fact that a uniform nomenclature has not yet been adopted by pathologists in dealing with the neoplasmata. Under the term "carcinoma," as here employed, are included neoplasms mainly composed of a disorderly growth of epithelium burrowing into some other tissue in the form of irregular cylinders, strings, and masses of cells — not surrounded by any basement-membrane,

[1] "New York Medical Journal," June 1891.
[2] Some of these results, however, are due to bad tuberculin or faulty observation.
[3] Reprinted from "The Practitioner," Vol. LXII., No. 4.

not arranged as a lining membrane to tubular or acinous spaces, and not exhibiting any orderly system of branching.

The term "adenoma," on the other hand, includes those neoplasms which comprise epithelium with more or less orderly arrangement, the cells being either disposed as a lining to tubular or acinous spaces resembling those of a secreting gland, or, when they form solid cylinders, being limited outwardly by a basement-membrane. A further character of the epithelial part of an adenoma is that the strings or cylinders of cells, whether solid or hollow, exhibit a considerable degree of regularity in their mode of branching, and in the proportion which they bear to the amount of newly-formed connective tissue or stroma.

In any discussion regarding the etiology of the carcinomata the adenomata cannot be excluded from consideration, for, while some of the latter may exist for a long period without any of the characters of malignancy (infiltrating mode of extension and metastasis), it is perfectly certain that the adenomata are not rarely very malignant growths. Furthermore, it is not at all rare to find that certain portions of a malignant growth exhibit an arrangement of epithelium which would entitle it to be enrolled with the adenomata, while in other parts of the same tumour the epithelium has that absolutely disorderly mode of growth which is characteristic of the carcinomata (adeno-carcinomata).

The tumours which originate from the epithelial surfaces of skin or mucous membrane, as opposed to the epithelial lining of glands, are probably always carcinomatous, in the sense above defined, from the outset; but the epithelial neoplasms originating in connection with glandular epithelium may at the outset be either carcinomatous or adenomatous, and in the latter case they may preserve the histology which simulates gland structure, or they may subsequently assume the carcinomatous type.

Not many years ago a distinguished pathologist asserted that carcinoma was a morbid condition peculiar to the human species. Had this been correct, the scope of our inquiry regarding the nature and causation of cancer would have been greatly reduced. There was, however, no justification for the statement, and at the present day every veterinary pathologist is well aware that cancer, although not very common, is not at all rare among some of the species of domesticated animals. It ought here to be observed, however, that little or no reliance can be placed on the writings of the older veterinary authors on the subject of cancer, owing to the fact that diagnosis was generally based solely on clinical and macroscopical characters. Needless to say, this tended to the inclusion under the head of cancer, not only of other malignant neoplasms (sarcomata), but also of inflammatory growths of bacterial origin. For example, the cases of so-called cancer of the tongue of the ox recorded even in comparatively modern veterinary text-books were probably without exception actinomycotic lesions. It is perhaps hardly necessary to state that in every case referred to in this article the diagnosis was verified by microscopic examination.

The following shows in tabular form some particulars relating to sixty-three cases of cancer in the domesticated animals which have been examined by the writer. In explanation of the meagreness

CARCINOMATA.

No.	*Animal.*	*Age.*	*Primary Tumour.*	*Secondary Tumours.*
1	Dog		Liver	Lungs.
2	Bitch		Mamma	
3	Dog	Middle-aged	Pharynx	
4	Dog	14 years	Prepuce	
5	Dog	10 years	Skin of back	
6	Dog		Prepuce	
7	Dog		Anus	
8	Dog		Anus	
9	Dog	Aged	Orbit	
10	Dog		Thigh	
11	Dog[1]		Skin of back	
12	Dog		Neck	
13	Dog		Neck	Cervical glands.
14	Dog		Anus	
15	Dog	15 years	Anus	
16	Dog	Aged	Anus	
17	Cat		Shoulder	
18	Cat	12 years	Tongue	
19	Horse	Aged	Antrum	
20	Horse		Antrum	
21	Horse		Orbit	Submaxillary lymphatic glands.
22	Horse		Stomach	
23	Mare		Antrum	
24	Horse		Penis	
25	Horse		Tail	
26	Mare		Bladder	
27	Horse	Aged	Penis	Sublumbar glands.
28	Horse	Aged	Stomach	Omentum, parietal peritoneum, diaphragm, pleura.
29	Mare		Vulva	
30	Horse		Penis	
31	Horse		Stomach	Omentum and parietal peritoneum.
32	Horse		Penis	
33	Horse		Penis	
34	Mare		Bladder	
35	Horse		Orbit	
36	Horse		Penis	
37	Horse[2]		Tail	
38	Mare	Aged	(?)[3]	Omentum and mesentery.
39	Horse		Fauces	
40	Horse	10 years	Penis	
41	Horse		Tail	
42	Horse	13 years	Antrum	
43	Mare	Aged	Mamma	
44	Cow		Liver	
45	Cow		Vulva	
46	Cow		Larynx	
47	Ox		Skin of body	
48	Ox		Scrotum	
49	Sheep (sex ?)		Liver	

[1] Melanotic. [2] Melanotic. [3] Primary tumour probably overlooked.

MALIGNANT ADENOMATA AND ADENO-CARCINOMATA.

No.	*Animal.*	*Age.*	*Primary Tumour.*	*Secondary Tumours.*
1	Dog		Liver	
2	Bitch		Liver	Lungs.
3	Bitch		Mamma	
4	Dog		(?)[1]	Lungs.
5	Bitch		Kidney	Lungs.
6	Bitch		Kidney	Other kidney, liver, and sublumbar glands.
7	Bitch		Mamma	Axillary glands and lungs.
8	Horse		Kidney	
9	Horse		Kidney	
10	Horse		Kidney	
11	Horse		Kidney	
12	Horse		Kidney	Omentum.
13	Mare		Mamma	
14	Sheep (female)		Liver	

[1] Multiple tumours in lungs; primary tumour probably overlooked.

of the details in most of the cases it may be mentioned that a large number of the tumours were included in the heterogenous collection of morbid specimens forwarded for diagnosis by members of the veterinary profession, who in many instances, for lack of opportunity or other reason, had not made a complete *post-mortem* examination. It is further unfortunate that in many cases the age of the animal was not noted, and, as a rule, little or no clinical history was obtainable. The table also includes malignant tumours excised from animals operated upon in the clinique of the Royal Veterinary College during the last six years.

It will be observed that the only one of the common domesticated species not represented in the table is the pig, and the writer has never met with a case of either carcinoma or adenoma in that animal. There appears to be no room for doubt that cancer is very rare in the pig. Of the forty-nine cases of carcinoma included in the table, twenty-five were in the horse, sixteen in the dog, five in the ox, two in the cat, and one in the sheep. The fourteen malignant adenomata and adeno-carcinomata comprised seven in the dog, six in the horse, and one in the sheep. A large majority of the animals were males, but the cases given do not afford data for comparing the relative frequency of cancer in the two sexes, for two reasons. In the first place, in the canine species the males are greatly in excess of the females; and, secondly, it is possible that in some of the cases the word "horse" or "dog" as used by the veterinary surgeon who sent the tumour may have been intended in the ordinary colloquial sense to indicate the species only, and not the sex.

A great deal might be written regarding the histology of these sixty-three tumours, but details under that head appear to be unnecessary. It may be observed, however, that the list includes no tumour with any special histological characters as compared with the varieties of cancer met with in man. In short, the carcinomata

and adenomata of the lower animals could not from their histological characters be referred to the species from which they were obtained, or distinguished from similar neoplasms from the human subject. They present the same variations with regard to the proportion and characters of the stroma, and the type of their epithelial cells.

Much greater interest attaches to the situation of the primary growths. In the sixteen carcinomata from the dog, no fewer than five came from the neighbourhood of the anus. It is worthy of mention in this connection that the anus of the dog is a not uncommon seat of development of an adenomatous tumour which has not been included in the list because of its benign characters. This tumour contains solid epithelial cylinders, limited outwardly by a basement-membrane, and arranged in a fine vascular connective tissue with as much regularity as the tubes or acini of a secreting gland. The tumour exhibits an interstitial, as opposed to a peripheral or infiltrating, method of growth, and it may be in existence for years without the occurrence of metastasis. But, as an illustration of the absence of a sharp boundary-line between even the more highly organised adenomata and the carcinomata, it may be mentioned that one of the carcinomata included in the table appeared to have started in connection with one of these anal adenomata.

It is interesting to observe that the twenty-five carcinomata from the horse included seven from the penis, four from the antrum, three from the tail, three from the stomach, and two from the bladder. The seven animals with cancer of the penis were all geldings, and the tumours were all of the so-called epitheliomatous or squamous-celled variety. Those from the antrum and from the stomach were of the same type. The latter had their origin in the left half of the stomach, which in the horse is lined by a mucous membrane similar to that of the œsophagus. All three of the gastric tumours were very malignant as regards their destructive effect on the stomach wall, and in two of them the disease was metastatic.

As compared with the incidence of the disease in human beings, the rarity of cancer of the tongue, uterus, and mammary gland is very remarkable. The preceding list includes only two cases of genuine mammary carcinoma, one of which occurred in the bitch and the other in the mare; and only three cases of malignant adenoma or adeno-carcinoma of the mamma, two of these being in the bitch and the other in a mare. The writer of this article has never seen a case of either carcinoma or adenoma of the udder of the cow, and so far as he is aware there is no authentic record of such a case. He has never seen a case of uterine carcinoma in any of the lower animals, and only one case of cancer of the tongue—viz., the one in a cat which is included in the table.

The relative, if not absolute, immunity of the udder of the cow from carcinoma is difficult to reconcile with the theory that carcinoma of the human breast is etiologically connected with the irritation incident to lactation. It is also to some extent opposed to the parasitic theory of cancer, for in respect of the frequency and variety of bacterial inflammations of the mammary gland the cow stands first among all the domesticated animals, and is far ahead of the human female. The occurrence of carcinomata in other parts of the body proves that the ox species has no general immunity from such growths, and, whether

one suppose that the hypothetical cancer parasite is an obligatory or a facultative one, there must be abundant opportunity for its entrance into the udder of the cow.

Still another point connected with the common sites of carcinoma in the lower animals bears upon the question of etiology. The figures already given show that carcinoma is by no means rare in the horse, but it is a somewhat singular fact that not one of the equine carcinomata included in the table had its starting point in any of those parts of the body which are specially exposed to the irritation of friction. None of the tumours had their origin near the common sites of collar or saddle galls, and each of the tail tumours started behind the point that is embraced by the crupper. The occurrence of carcinoma of the glans penis of the stallion has been ascribed to the irritation of copulation repeated with unnatural frequency, but that theory is disposed of by the fact that the whole seven cases of carcinoma of the penis included in the table occurred in geldings.

In connection with the question of injury and irritation as a cause of cancer, it deserves to be stated that the tumour No. 47 in the list was said to have been taken from the skin of an ox where the animal had been branded with the hot-iron. The portions of the tumour submitted[1] for examination had a typically carcinomatous structure. Against this may be set the fact that firing with the hot-iron has been a very common veterinary operation throughout the whole of this century, but it has never been observed that it is apt to be followed by carcinoma.

With respect to the age at which it occurs, cancer in animals seems to follow the rule observed in the human species, the individuals attacked being nearly always middle-aged or old.

PREVENTIVE INOCULATION.[2]

A DISCOURSE DELIVERED AT THE ROYAL SOCIETY, LONDON, ON 8TH JUNE, 1899.

By W. M. HAFFKINE, C.I.E., Bacteriological Research Officer to the Indian Government.

THE most important modern methods of prophylactic treatment are based upon the fact that an attack of disease from which an individual recovers leaves in him a condition of resistance to another attack. The possibility of turning to advantage this fact was first demonstrated to us by Mahomedan physicians, to whom the world thus owes the knowledge of what proved to be one of the most fertile principles of modern science. The successes of Jenner and Pasteur, who utilised cultivated virus for preventive treatment, have led to a general conception that there is the possibility of creating artificial immunity to diseases by treating the organism with morbid products rendered by some special means harmless. This definition involves a generalisation which led to a considerable amount of disappointment, as the applica-

[1] By Mr Archibald Park, M.R.C.V.S., of Hobart Town, Tasmania.
[2] Reprinted from "The Lancet."

tion of the principle in a number of instances did not give the expected results.

Derivates from Microbial Virus and their Effect.

When we cultivate a pathogenic micro-organism in a liquid medium two different elements are obtained mixed together: the bodies of the microbe and the liquid which it has modified and into which it has secreted its own products. A modification of the entire preparation, as represented by this mixture, can be first of all obtained by filtering the two elements just mentioned and considering each of them by itself; or else the two can be left together and only the vitality of the microbe destroyed by some physical or chemical agent; or the constitution and the properties of each or of both of these elements can be to a desired degree altered by the admixture of chemicals or by subjecting them to physical processes; or else the vital and pathogenic properties of the microbe can be modified by artificial breeding, and then the microbe itself or the products of such a modified microbe used for treatment. The immediate effect which a given virus or its derivate produces on an animal differs with the kind of virus taken, the process of modification to which it has been subjected, and the species of animals upon which it is used. The following instance may give an idea of these variations.

The ordinary Indian grey as well as the brown monkey are susceptible to the plague virus and may contract a fatal disease from being simply pricked with an infected needle. The rabbit and guinea-pig are also susceptible to the disease. The horse on the contrary, contracts no fatal disease after being infected even with large doses of the living virus. If, however, a plague culture be heated and the microbes killed in it the relations between the monkey and the horse seem to become the reverse of the former, the guinea-pig remains comparable with the monkey, while the rabbit shares with the horse the susceptibility which it shared first with the monkey. It will require, according to several observers, a very large dose of such treated virus to produce in the monkey or in the guinea-pig any marked rise of temperature or any alteration of the skin at the seat of injection, while the horse answers to the injection by almost as brisk an attack of fever as if the virus were a living one, and at the seat of inoculation a tumour is produced which, if the dose be at all considerable, may lead to a complete mortification of the tissue. The rabbit similarly answers to the injection by an attack of fever and by the formation of a hard tumour at the seat of injection.

As varied as is the immediate effect of different forms of virus upon different animals, so varied is the result of the application of such virus from the point of view of immunity conferred by it. There are animals in which the inoculation leaves no lasting effect whatever. In others a very temporary immunity is created, vanishing away in a few days. In other cases, again, a condition appears that produces the impression as if after the treatment the animal has become more susceptible to a subsequent infection than is a normal, not so treated animal. And, lastly, there may be found animals in which the same virus will produce a great and long-lasting immunity. In general I believe it to be admissible that in the case of every disease and with regard to every species of animals a form of treatment may be found

that will produce immunity against disease in that particular case, but the same method of treatment may or may not be applicable to another animal or to another disease affecting the same animal. It is the not taking into account of this variation of circumstances that I believe more than anything else has checked the success of a number of experimenters.

Immunity against Attack and Resistance against the Actual Symptoms of the Disease.

The study of the anti-cholera inoculation in India has revealed a new problem in the subject of prophylactic treatment. The particular character of cholera epidemics which appear unexpectedly, do not last, and in places where they are permanent are spread and scattered over large areas makes the study of that disease and the demonstration of the effect of a preventive treatment in its case a matter of much greater difficulty than is the case in localised contagious diseases like small-pox or in plague; and although a large amount of material has been collected already it is desirable that a number of observations be added to the present ones confirmatory of the results obtained. The information collected permits, however, already of pointing out very important features in the working of the anti-cholera inoculation. The most extended and continuous observations on the subject were organised by the municipality of Calcutta upon the enlightened initiative of Dr W. J. Simpson and under his continuous supervision as well as my own. These observations refer to the cholera-stricken suburbs of Calcutta, the so-called "busties" or groups of huts situated round the tanks where rain water is collected during the monsoon. Some 8000 people were inoculated in those localities and for two years observations were made and the results collected as to the occurrences of cholera in the huts inhabited by the inoculated. In the vast majority of cases there lived in the same families members who had not been inoculated together with others inoculated, and the possibility thus presented itself of comparing the incidence of the disease in individuals of the same households, exposed as much as is possible to the same chances of infection.

During the time under observation cases of cholera occurred in seventy-seven huts. As a result of careful investigation of these cases[1] it was seen that for a period of 738 days cases of cholera occurred among the uninoculated at all intervals after the date of inoculation; whereas the figures referring to the inoculated showed a striking variation of the incidence when compared at various distances from the time of inoculation. Cases continued to occur among the inoculated for a period of four days after the treatment, and then for 416 days the inoculated practically remained free from the disease, only one death having occurred among them during that time. From the 421st day up to the end of the observation six cases occurred among them again. The relative immunity in the inoculated, considered separately during those three periods, shows that during the first four days the inoculated had proportionately 1·86 times fewer deaths from cholera than the uninoculated. During the period between

[1] Vide Health Officer's Report to the Chairman of the Calcutta Municipal Corporation, reprinted in the "Indian Medical Gazette," Vol. XXXI., No. 8, August 1896.

the 5th and 420th days—*i.e.*, for a period of nearly fourteen months—the number of deaths among the inoculated was twenty-two, sixty-two times smaller than amongst the uninoculated. And for the rest of the time under observation the proportion in their favour fell to 1 to 1·54. The plan has since been formed to try the effect of larger doses and of stronger vaccine in order to obtain a more lasting protection.

While thus the absolute number of cases and deaths from cholera appeared so strikingly influenced by inoculation, the particularity that came out from the observations in Calcutta as well as in other places was that the proportion of deaths to cases did not appear to be changed by the treatment. Thus, in the observations made in a camp of coolies of the Assam-Burmah Railway Survey, out of thirty-three attacked among the uninoculated portion of the camp twenty-nine died, and of four attacked among the inoculated all four died. In the Durbhanga prison out of eleven uninoculated attacked all eleven died, while of five inoculated attacked three succumbed. In the Gaya jail twenty uninoculated attacked had ten deaths, and eight inoculated attacked had five. In a group of tea plantations in Assam 154 cases in uninoculated had sixty deaths; fifteen cases in inoculated had four. In the East Lancashire Regiment in Lucknow 120 uninoculated attacked had seventy-nine deaths, and eighteen inoculated attacked had thirteen. This circumstance, the non-reduction of the case mortality by a treatment which influenced unmistakably the case incidence, appeared as an astonishing divergence from the result of small-pox vaccination, where both the number of attacks and their fatality are reduced by the treatment. The new aspect of the problem of preventive inoculation which thus presented itself in the observations on human communities consisted in the possibility of a prophylactic treatment being directed separately towards the reduction of the number of attacks, leaving the fatality of the disease unchecked, and towards the mitigating of the character of the disease and the reduction of the case mortality in those who are attacked.

Possible Relation between the Two.

In analysing the nature of this particular result the following two facts known in the laboratory practice presented themselves to me as of essential significance. In patients who recover from an infectious disease the pathogenic microbe does not disappear from their body for a considerable time after their recovery. It does not do them harm any longer, though when transferred to another animal it may still cause a fatal attack. Similarly, as in the case, for instance, of a guinea-pig inoculated with the bacillus of chicken cholera, a naturally immune animal can breed for weeks in an abscess microbes of an intense virulence without in the least suffering in its own general health. A condition seems to set in in the convalescent patient, or to exist in naturally immune animals, whereby they may not suffer from the result of activity of a pathogenic microbe, from its morbid products; and from that time the presence of the microbe in the system, even in the tissues, becomes innocuous. Immunity against symptoms generated by the products of microbes does not seem to imply necessarily the ridding of the system of such microbes. It is known now, since the discoveries of Behring and Kitasato, that such

a resistance against the products can be originated artificially by gradually treating the system with increased quantities of toxins. The system reacts by developing antitoxins, tending to neutralise the effect of the toxins. On the other hand, Gamaleia first attracted attention to the fact that it is possible to create in an animal resistance against lethal doses of virulent microbes without that animal getting any resistance against a dose of the products prepared from the microbe in the laboratory. One seems justified, therefore, to consider separately two kinds of immunity—one against the living microbe, which would prevent it from entering the system and causing an attack; and another against the fatality of the symptoms of the disease, caused by the products of the microbe when the latter overcomes the initial resistance and does invade the system. In the inoculation against cholera, which is done with the bodies of microbes, the first result alone is obtained.

These considerations came to be strengthened by a set of laboratory experiments by Pfeiffer and Kolle, intended for verifying our Indian results, and in the course of which they detected in the serum of men inoculated with only one dose of cholera vaccine an extremely high protective power, equal to that which—in goats, for instance—could be created only after a very prolonged treatment, extended over five or six months, and including injections with gigantic doses of cholera vaccine. On analysing in detail the properties of that serum, they found that it possessed an intense power of destroying the cholera microbes, but exhibited no antitoxic properties capable of neutralising the effect of the products of those microbes.

The Plan of Anti-Plague Inoculation.

When, in 1896, I was confronted with the problem of working out a prophylactic treatment against the plague, I determined to put to test the ideas originated by the observations on our cholera patients, and to attempt, in the new preventive inoculation, to obtain at once a lowering of the susceptibility to the disease and a reduction of the case mortality. This I resolved to obtain by treating the system with a combination of bodies of microbes and of concentrated products of them. In giving the above considerations I beg that they should be considered as temporary, subject to modification or to complete refutation. There may exist already facts unknown to me which are opposed to the guesses implied in them. It was those guesses which led to the results obtained in the plague inoculation; but in giving the reasoning which I passed through while working out the method I am yielding only to a demand to that effect, as I consider that part of my communication unnecessary; the more so that the theoretical conjectures above enumerated are not shared by a number of experimenters, such as Pfeiffer himself, to whose results I owe some of my premisses; and the correctness of the composition of the plague prophylactic with regard to the extra-cellular toxins which I have added to it is subjected to theoretical contest. It is certain that no theoretical conjectures conceived by one experimenter are binding or need even be interesting to others. What is obligatory is the acceptance of the actual results obtained.

The Plague Prophylactic.

In order to accumulate for the plague prophylactic a large amount of extra-cellular toxins, the bacilli are cultivated on the surface of a liquid medium, where they are suspended by means of drops of clarified butter or of cocoanut oil. The bacilli grow down in long threads into the depth of the liquid, and produce what we have termed a stalactite growth in broth, an appearance singularly peculiar to this microbe, and which, I hope, will be, till further discovery, accepted as the specific diagnostic feature of this microbe. The products of their vital exchange—the toxins—are secreted by the stalactites into the liquid and accumulated there. The growth is periodically shaken off the drops of oil, after which a new crop appears underneath the surface of the liquid. Thus a large quantity of bodies of microbes is collected at the bottom of the cultivation vessel, and the liquid itself gets gradually permeated with increasing quantities of toxins. The process is continued for a period of from five to six week, at the end of which the bodies of the microbes get extremely deteriorated. It will be seen from this that, in my eagerness to put to test our ability of influencing the case mortality, I may have perhaps paid less attention than I might have done to the problem of reducing the number of attacks, and I have now sketched out a simple plan whereby to test this circumstance, and to try to further improve our results from this point of view. In order to render harmless the inoculation of the virus above described, I determined to kill the microbes by heating the material up to from 65° to 70° C. The virus so treated, differently from what one observes in some other instances, loses at once for the animals susceptible to the disease almost all its pathogenic power, and it was a question to determine whether it contained qualities that were sought for—viz., the power of creating in man a useful degree of resistance to plague. The plan has been contested by a number of experimenters, who tried a material similarly prepared on different animals, and failed to detect in it any immunising properties. Among other forms of plague virus which were tested by us and by other experimenters a large number were found to be too dangerous to use; in other instances the mode of application was inadmissible in the case of men; in others, again, the effect appeared too evanescent to be of practical use.

The Properties of the Plague Prophylactic.

The immunising effect of the plague prophylactic as above described was worked out on domestic rabbits, and its actual efficiency on these animals was since verified and confirmed by a number of experimenters by trying to infect with virulent plague protected and unprotected animals. Comparing the rabbit with other laboratory animals, such as the rat, the guinea-pig, the mouse, and the monkey, one may consider the rabbit as the one that perhaps required the least amount of protection, as its natural resistance to plague is relatively high. The most altered virus—*i.e.*, such as was rendered the most harmless of all—was found to confer on the rabbit a very considerable degree of immunity, enabling it in a few days to resist

ten- or fifteen-fold lethal doses of virulent plague microbes. The same treatment applied to animals of a more susceptible nature would, on the contrary, in many instances fail.

The Questions which were to be Solved by Experiments on Human Beings.

At the end of our laboratory experiments a very definite set of questions stood before us, which were to be solved by direct experiment on human beings. Those questions were: 1. Would man behave with regard to the prophylactic like the animals upon whom its protective power had been worked out? 2. If it so happens that the answer is affirmative, what would the dose of the prophylactic and the method of administering it be; and would not the dose required be so high, and the reaction to be produced so severe, or the number of inoculations to be repeated so great, as to render the treatment inapplicable to men or impracticable? 3. How many days, counting from the date of inoculation, would it take to produce in man a useful degree of immunity? 4. How long would that immunity last? And, lastly, there followed two questions, to which my experience of the anti-cholera inoculation entitled me to give a reassuring answer, but which it was necessary to verify in plague again—viz.: 5. During the period of reactionary fever and all the other symptoms produced by inoculation, will the resistance of the inoculated exposed to plague be, for the time being, reduced, or remain the same, or be increased—*i.e.*, would it constitute a danger to apply the inoculation in localities actually affected with plague? and 6. When a man who happens to be incubating the plague, or to have initial symptoms of the disease already, chances to be inoculated, would it aggravate his condition, or have no effect, or, on the contrary, help him?

Demonstration of the Harmlessness of the Inoculation.

The perfect harmlessness of the inoculation was first of all demonstrated by the officers of the laboratory, the principal and professors of the Grant Medical College, a large number of leading European and native gentlemen of Bombay, and their families and households being inoculated; and after that when, in the last week of January 1897, the plague broke out in Her Majesty's House of Correction at Byculla, in Bombay, the option of inoculation was offered to the prisoners.

The Experiment in Her Majesty's Byculla House of Correction, Bombay.

The Byculla Jail is a long-term one. There are no children or very young people among the inmates, there being in Bombay a separate establishment, the Sassoon Reformatory, where minor criminals are sent. The prisoners of the House of Correction present a well-fed, well-clad, regularly worked, and almost as uniform a set of people as can be seen in a regiment, amongst whom one could scarcely see a single infirm or very aged individual. At the appearance of plague the prisoners numbered 346. The inoculation was introduced after nine cases of plague had already occurred, five subsequently ending fatally; there remained thus 337 individuals to be dealt with. Of these 154 only volunteered for inoculation and 183 remained uninocu-

lated. On 30th January, in the forenoon, before the inoculation was applied, six more cases occurred, of which three afterwards proved fatal. The inoculation was applied in the afternoon, and afterwards it was discovered that one more prisoner had already a bubo on him when inoculated, while two prisoners developed buboes in the same evening after their inoculation. These three inoculated, attacked in the evening of inoculation, proved also fatal. After that the difference observed in the fate of the two groups, the inoculated and uninoculated, is seen from the subjoined table:—

Date of Occurrence of Plague.	*Occurrences in uninoculated.*			*Occurrences in inoculated.*		
	Number of uninoculated present.	*Cases.*	*Fatal.*	*Number of inoculated present.*	*Cases.*	*Fatal.*
Jan. 23rd to 29th, 1897, previously to the day of inoculation	—	9	5	—	—	—
30/1/97, the day of inoculation: Forenoon, before inoculation	—	6	3	—	—	—
30/1/97, the day of inoculation: Afternoon, after inoculation	—	—	—	—	3	3
First day after inoculation, 31/1/97	177	2	1	151	1	—
Second day after inoculation, 1/2/97	172	1	1	150	—	—
Third day after inoculation, 2/2/97	173	1	1	146	—	—
Fifth day after inoculation, 4/2/97	171	1	1	146	—	—
Sixth day after inoculation, 5/2/97	169	2	1	146	—	—
Seventh day after inoculation, 6/2/97	169	5	1	146	1	—
Total after the day of inoculation	172 uninoculated, average daily strength.	12 cases.	6 deaths.	147 inoculated, average daily strength.	2 cases.	No deaths.

For seven days, except the fourth, after inoculation cases of plague continued to occur among the uninoculated group, their average daily strength throughout the week being 173; altogether twelve cases occurred among them, with six deaths; while in the 148 inoculated there was one case on the next day after inoculation, which rapidly recovered, and one on the last day of the epidemic, which recovered also.

Analysis of the Results of the Byculla Jail Experiment.

A glance at the above table will show the progress which was made in our information by that initial experiment, and how far it carried us ahead from the state of uncertainty which surrounded the question originally. The dose of prophylactic administered to the prisoners

was three cubic centimetres. They all had the customary attack of fever from the operation, with the discomfort accompanying that condition—a headache in many cases, nausea, loss of appetite for a couple of days, a feeling of fatigue and lassitude, reminding one of a mild attack of influenza, and with swelling and pain in the inoculated side. Did, however, all this make them more susceptible to the disease than were their non-inoculated fellow inmates? It is certain that the table testified unmistakably to an opposite result. Further, the incubation period in plague appears to be, on the average, five days, extending, however, not unfrequently up to ten. Of the twelve prisoners in the uninoculated group who developed plague during the next few days after the date of inoculation, a large proportion, if not all, must have been already incubating the disease on that day; and seeing the perfect similarity of conditions under which the inoculated and the uninoculated, who came from the same crowd of people, were living, one could infer safely that a similar group of individuals incubating plague was present among the inoculated also at the time when the inoculation was performed on them. The inoculation, however, did not aggravate their condition, as the number of inoculated who developed plague, counting from the first twelve hours of inoculation, was proportionately five times smaller than the corresponding number among the uninoculated; and the two cases that appeared among the inoculated, one on the very next morning after inoculation, both ended in recovery. As far as that first experiment went, therefore, men behaved like the laboratory animals which derived protection from the inoculation. For communicating that protection one injection of prophylactic appeared sufficient with a dose of three cubic centimetres, which dose, however, in our subsequent operations was further reduced to two and a half cubic centimetres. The difference in favour of the inoculated appeared within some twelve hours after the operation, but the man who was inoculated with plague on him and the two who developed clear symptoms of plague the same evening did not benefit by the operation. This completed the first information gathered with regard to five of the six questions enumerated above. No answer could be given as to the final duration of the effect of inoculation except that the operation appeared to be useful in a localised already existing epidemic extending over seven days.

The Experiment in the Umerkadi Common Jail, Bombay.

In the next case the strictness of the conditions of the last experiment was enhanced further. This was in the second Bombay gaol, the so-called Umerkadi Common Jail. The plague broke out there at the end of December 1897, and by 1st January 1898, three prisoners were attacked and all of them subsequently died. In the interval between the operations in the two jails some 8000 people in the free population of Bombay had already availed themselves of the inoculation. This time the whole of the prisoners, numbering 401, appeared willing to undergo the preventive treatment. In view of the novelty of the operation, however, and of our responsibilities before the Government and the public, and the necessity of demonstrating clearly the effect of inoculation, the prisoners were not allowed to undergo the treatment in a body and it was resolved that only one-half of them should be permitted to do so. The manner in

which that half was selected guaranteed the elimination of all possible errors usually inherent to observations on free human communities. The population of a jail in India is gathered into several groups, the largest being the ordinary convicts divided into simple prisoners and convicts sentenced to hard labour; then there is a group of civil prisoners (debtors), then a group of prisoners under trial, of convict warders, of cooks, of bakers, of men employed in the infirmary, etc., and a separate group of female prisoners.

On the morning of 1st January 1898, in the presence of Major Collie, I.M.S., and Dr Leon, the medical officers, and of Mr Mackenzie, the superintendent, and of all the officials of the jail, the above groups were brought one after the other into the jail-yard and asked to seat themselves in rows; and after all had been so seated every second man without further distinction was inoculated, excepting two of them who did not volunteer for the treatment. From this moment the pair numbers, the inoculated, were left to live with the uninoculated under as identical conditions as were those in which they were living before. They had the same food and drink, the same hours of work and of rest, and they shared with them the same yards and building, etc.

In this case fatal attacks continued to occur in the jail for thirty days, during which time an almost equal number of prisoners, inoculated and uninoculated, were discharged from jail and thus excluded from further observation. The average daily strength of the uninoculated who remained in the jail up to the end exposed to the plague was 127, and of the inoculated 147. In the smaller number of uninoculated ten cases of plague occurred, six of them proving fatal; while the larger number of inoculated produced three cases, of whom all recovered. In these three cases, however, in the inoculated, the character of the disease was so much mitigated that the authorities of the Government hospital at Parel, Bombay, where they were sent, hesitated to return them as plague cases, and the Director-General of the Indian Medical Service who examined two of them diagnosed them as mumps. They were returned as cases of plague in order that no possibility of error in favour of inoculation should be admitted.

The Experiment in the Dharwar Jail.

On the third and last occasion when the plague broke out in a jail one did not feel justified in withholding the inoculation from any of the inmates and all of them were permitted to be inoculated. This was in Dharwar during the terrible outbreak of plague in that town and district, the news of which must have reached you even here. Five cases of plague occurred, of which one was imported, and four in old residents of the jail, and all five ended fatally. The prisoners, then numbering 373, submitted in a body to inoculation and only one case of plague followed, in a man who had been attacked two days after the operation and who recovered, being the only one who did not succumb.

The Experiment at Undhera in a Free Population.

The most carefully planned out and precise demonstration of the working of the prophylactic system in the free population which was

exposed to a greater amount of infection than the prisoners in the jails was that made in the village of Undhera, six miles from Baroda. The following was the mode of operation adopted. A detailed census was made by the authorities of all the inhabitants of the place and on 12th February 1898, when a committee of British and native officers arrived to carry out the inoculation, the people were paraded in the streets in four wards family by family. Major Bannerman, I.M.S., of the Madras Medical Establishment, and myself, accompanied by the Baroda officials, went from one household to another and within each inoculated half the number of the male members, half that of the females, and half that of the children, compensating for odd figures that happened to be in one family by odd figures in another. I personally and the officers who were with me directed special attention to distributing the few sick in the two groups of inoculated and uninoculated as equally as our judgment permitted us to do. The plague, which had carried away before inoculation seventy-nine victims, continued afterwards in this instance for forty-two days and appeared in twenty-eight families, in which the aggregate number of uninoculated was sixty-four and of inoculated seventy-one. The total number of attacks in those families was thirty-five and they were distributed as follows. The sixty-four uninoculated had twenty-seven cases with twenty-six deaths, and the seventy-one inoculated had eight cases with three deaths, thus showing 89·65 per cent. of deaths fewer in the inoculated members of the families than in the uninoculated. There were no deaths from other causes in the inoculated of the village, while among the uninoculated there were three deaths attributed to other causes than plague.

The subjoined figures show the number of days which elapsed between the days of inoculation and the occurrence of a death from plague in these families. The first row of figures refers to occurrences in uninoculated members, the second to occurrences in inoculated, while the small figures show the number of deaths which occurred in each group on those days.

Deaths from plague occurred in uninoculated and in inoculated :

3^2 4^1 5^3 7^2 8^3—10^3 11^3 12^1————15^1 16^1 19^1 20^1 21^1 24^1 32^1 and 42^1

————————9^1————12^1 and 14^1————————————

days after date of inoculation.

There elapsed, therefore, eight days during which eleven deaths from plague occurred among the uninoculated members of the families before the first death took place in an inoculated case. The inoculation has again acted, so to say, immediately; or, as we have adopted to generally formulate the result, has acted within the time necessary for the subsidence of the *general* reactionary symptoms produced by the inoculation.

The investigation in this village was carried out by Surgeon-General Harvey, the Director-General of the Indian Medical Service, and a committee of British and native officials. Every member of the family who survived was seen, his particulars verified from the documents, and every detail was confirmed from the registers kept at the time and from the testimony of the whole of the villagers who were present throughout the inquiry.

Experiments on a Large Scale and Averages of the Results Obtained.

I have dwelt so long upon the description of the above experiments, not because they were the largest in volume or the most striking which were made, but because they were the most precise of all and, as far as I am aware, free from any possible loophole of mistake. I made prolonged and detailed observations in very severely affected communities of Lanowlie in a population of 700 people, and of the followers of the artillery at Kirkee, numbering at the time 1530. Very complete data were collected by Professor R. Koch and Professor Gaffky of the German Government Commission, by Major Lyons, I.M.S., and by myself in the Portuguese colony of Damaon in a population of 8230 individuals, during a frightful outbreak of plague there, extending over four months, in 1897. A minute investigation, extending over several months, was made by me in the Khoja Mussulman community of Bombay, numbering some 10,000 to 12,000 people, where about half of the total number were inoculated under the auspices of His Highness the Aga Khan. A most comprehensive inoculation campaign and with widely reaching and most satisfactory results was carried out under the Collector of Dharwar by Captain Leumann, I.M.S., Dr (Miss) Corthorn, Dr Hornabrook, Dr Foy, Dr Chenai, and others in the three adjacent small towns of Hubli, Dharwar, and Gadag, where some 80,000 people were inoculated. The latter was the most magnificent piece of work done, from the point of view of practical application of the method. With the extension of the number of inoculated the exactitude and precision of observation must, however, suffer.

A number of doubts and possible objections with regard to many particular points arise which it is not always possible to answer with certainty. Such observations are required to enable us to judge whether the application of the method as a general measure answers to the expectations formed, but the exact extent of the results is to be gathered from such mathematically precise experiments, imitating the conditions of laboratory practice, as were those which I have detailed above. The difference in the mortality from plague between inoculated and uninoculated parts of communities was estimated to average over 80 per cent., approaching often 90, as was the case in Undhera, the lowest proportion ever observed in the experiments which I made personally having been 77·9 per cent. This was at Kirkee.

Case Mortality Reduced by 50 Per Cent.

A very accurate set of data were collected in almost all the larger hospitals where inoculated plague cases were admitted upon the fatality of the disease in the inoculated. These were to the effect that the case mortality among the inoculated was some 50 per cent. lower than among the uninoculated plague cases. A number of documents on this point have been collected by the Indian Plague Commission and will appear, I trust, in their records.

Minimum Duration of the Effect of the Plague Inoculation.

As to the duration of the effect of the plague inoculation the statement which can be made for the present is that it lasts at least

for the length of one epidemic, which on the average extends from over four to six months of the year. The government of India have recognised the inoculation certificates, entitling the holder to exemption from plague rules, to be valid for a period of six months, with the understanding that if accurate data are forthcoming of the effect lasting longer the holders will be permitted to exchange their certificates for another period without being reinoculated.

The Further Problems Pursued in the Bombay Plague Research Laboratory.

The task which the officers of the Bombay Plague Research Laboratory have proposed to themselves in connection with the prophylactic inoculation comprises now the following problems: (1) the working out of proceedings for turning out uniformly large quantities of material and avoiding the variations due to the character of the plague microbe and to the differences in the composition of the cultivation media; (2) the further investigation of the different constituents of the plague prophylactic with a view of enforcing those which produce definite and beneficial results; (3) the possible mitigation of the reactionary symptoms after inoculation; and (4) the study of the effects of antiseptics used for preserving the prophylactic; while their most important general problems concerning plague refer to the study of the curative treatment of plague and to the life-history of the plague microbes in nature.

The Typhoid Inoculation.

Permit me now to enter a pledge in favour of a new inoculation campaign which has been inaugurated already and which I hope will be carried out successfully for the benefit of a large number of soldiers of this country residing in India and of white men in general in all tropical countries. The problem of typhoid inoculation has quite a special interest for Europeans, as much as cholera has for the natives of India. Typhoid fever proved to be a more difficult disease to eradicate from military cantonments than cholera. It is possible that the explanation of that lies in what is already known of the character of the microbes of these diseases. The typhoid bacillus when subjected to different chemical and physical agents, such as acids or antiseptics, or a high temperature, or desiccation, or the admixture of other microbes, appears far more resistant than the cholera microbe. Such a character would ensure for the typhoid bacillus the existence in more varied media under more various climates and a greater independence from seasonal or local changes than is the case with the cholera microbe. Outside the endemic area the cholera remains in one and the same place for a few weeks and in any given part of a town often for a few days only. It is rare that it visits one and the same barrack more than once in five years, sometimes ten years, and when it occurs a temporary evacuation of the place puts a stop to the disease. The typhoid virus, on the contrary, sticks to an infected locality for years and causes a continuous incidence of the disease, for which occasionally nothing short of a complete desertion of the station is effective. At the same time, while the cholera infection seems to be almost exclusively confined to the water-supply, in typhoid fever the improve-

ment of the water seems to leave intact a large number of other sources of danger which up to the present time have escaped recognition. Differing thus in their life-history in nature, the bacilli of cholera and typhoid fever present important common features in the manner in which they behave in the human and animal body. The chief centre of infection in both instances is the intestinal canal, the circulatory system remaining free from invasion. When inoculated into animals both microbes admit of the same kind of transformation by passages from animal to animal, and against both immunity can be created in the laboratory by the same preparation of virus as used in the inoculations for cholera, while when examining the tissues of immunised animals the same modifications are detected in them as those observed after the anti-cholera inoculation. These considerations have led us to expect from the typhoid inoculation in man a similar protective effect as that observed in the inoculation against cholera, and seeing that the period of life during which the new-comers to India remain susceptible to typhoid fever extends only over a few years it seems that the application of the system, when properly organised, is likely to prove of a very high practical value.

Inoculation and General Sanitary Measures.

The anti-cholera inoculation, the inoculation against plague, and that against typhoid fever came to associate themselves to vaccination and represent attempts at dealing with epidemics on lines differing from measures of general sanitation. During the last few years the question was therefore frequently debated as to the relation in which the two stand to each other. It is scarcely necessary to say that inoculation cannot be substituted for a good water-supply, the draining, cleansing, or improvements in the building of cities, or for the admission of a larger amount of light and air into over-crowded localities, for all those measures to which the nations owe such a wonderful improvement in health as has taken place during the present century. Only injustice would be done to the sanitarian by calling him in when a patient lies already on his sick bed or when an epidemic actually breaks out in a community, and by asking him to stay the sickness or the epidemic, to improve the health of the population, so to say, while you wait. Epidemics, like individual diseases, require specifics, promptly administrable remedies, to be dealt with, and measures of general sanitation can be no more advised for arresting an outbreak of cholera or plague than can an individual patient be directed to build for himself a new house, or to dry up the marshy lands, or to cut down the jungle round his habitation when he requires a dose of quinine to arrest an attack of fever. The part of vaccination and of preventive inoculation in combating epidemics stands in the same relation to general sanitary measures as therapeutics and the art of the healing physician do to domestic hygiene. It is certain that neither of these can ever be substituted for the other.

Inoculation and the Segregation-Disinfection Method.

A comparison of a different kind now very actively discussed is that between the methods of combating epidemics by separation of sick and

healthy and disinfection on the one hand and by preventive inoculation of the people on the other. From this point of view the following distinction between infectious diseases is to be made. When we take some affected tissue from a leper, or a pustule from a small-pox patient, or virulent saliva from a rabid animal, or some syphilitic matter, and throw it into milk, broth, or any organic substance such as is to be found in the ordinary surroundings of men, it produces no modification in the medium and in the course of time loses its infective properties and dies out; when, on the other hand, we repeat the experiment with cholera, or plague, or typhoid products, instead of dying out the contagion begins to grow and multiply, spreads in the medium, and soon transforms the whole of it into one mass of infectious matter. It is evident that such a distinction—the strictly parasitic nature of one microbe and the capacity of the other to lead both a parasitic and saprophytic life—must impress most directly the ways in which these diseases spread and assume epidemic forms and also the measures which are likely to be effective in combating them. In the first instance the infection must remain confined entirely, or almost so, to the body of the patient and the disease can be propagated only directly from individual to individual or by means of their immediate belongings. It is the inability of a virus to grow in lifeless nature that communicates to that disease a strictly contagious character. In the second case, provided the surrounding conditions be favourable to it, the virus will spread rapidly around the original focus and the sources from which infection reaches fresh individuals grow in number rapidly.

From the point of view of preventive measures, therefore in diseases like rabies, or syphilis, or small-pox, or leprosy, where infection can be found in the patient alone, precautions of isolation taken with regard to the sick and their closest surroundings must affect directly the prevalence and propagation of the disease; whereas in typhoid fever or cholera, and in plague also, where the patient is only one, and proportionately a limited source of danger, his isolation and the destruction of his belongings leaves unaffected the vast cultivations of infection which are going on in nature besides; and measures taken for circumscribing the prevalence of an epidemic by isolating and destroying the foci of infection are less likely to succeed in this category of diseases; attempts at eradicating an epidemic or at protecting individuals by ways which succeed in merely contagious affections will be in this case easily eluded; and the necessity of personal protection by means of a prophylactic treatment will soon be urgently felt and acknowledged.

CONGENITAL TUBERCULOSIS IN THE CALF.

By J. M'FADYEAN, Principal of the Royal Veterinary College, London.

I DO not propose to discuss in this article the relative frequency of congenital tuberculosis in the bovine species or the practical importance of that method of transmission in the dissemination of the disease among cattle. I have on many occasions maintained that, on account of its comparative rarity, intra-uterine infection with tubercle bacilli may be left out of account when we are considering the methods by

which the spread of tuberculosis among cattle may be checked, and at the present day that view has obtained almost general acceptance among both human and veterinary pathologists. Furthermore, it is a truth which is being gradually assimilated by the stock-owners of this country.

On this occasion it is intended to call attention to the usual distribution of the tuberculous lesions in congenital cases of the disease, to contrast this distribution with that generally encountered in adult victims of tuberculosis, and from the differences brought to light to draw certain inferences as to the method by which the bacilli are generally conveyed from place to place within the bodies of adult cattle.

In the first place, the distribution of the lesions in three cases of congenital tuberculosis in calves that have recently come under my notice will be described.

Case I.

In this case I had not an opportunity to make a complete *post-mortem* examination, as only portions of the obviously diseased viscera of the calf were forwarded to me.[1] The calf was killed in the Edinburgh slaughter-house, and it had been bought at a public sale. Nothing could be ascertained as to the condition of its dam. The state of the umbilical cord and horn of the claws showed clearly that the animal was only a few days old at the time when it was killed. The parts sent included the following:—

Liver.—This organ had numerous yellow tubercles, rather smaller than barley grains, scattered through its parenchyma. A hepatic lymphatic gland in the portal fissure was about twice the size of a garden bean, and on section its substance showed some streaks of caseation.

Spleen.—The pulp of this organ had embedded in it yellow tubercles rather larger than those in the liver, but only about half as numerous.

Lung.—The pulmonary tissue contained tubercles about the same size as those in the spleen, but wider apart.

Heart.—Only a part of this organ was sent, including two inches (in vertical measurement) at the apex and a piece of the outer wall of the right ventricle. The latter contained a single pea-sized yellow tubercle.

Structure of the Tubercles.—The whole of the tubercles were firm, and had small yellow caseous centres. Microscopic examination showed that the undegenerated parts were composed of epithelioid cells, with a variable number of giant cells. The necrotic and caseous centre of each tubercle was partially calcified. Tubercle bacilli were easily demonstrable in the lesions, but nowhere very numerous.

Case II.

This calf was killed when a week old, and offered for sale at the City Meat Market, Birmingham, in March last.[2] The mother of the calf was also killed in Birmingham at the same time, and it was noted that the animal's lungs were tuberculous. No other lesions

[1] For those interesting specimens I am indebted to Mr W. S. Grinton, M.R.C.V.S., Edinburgh.

[2] It was condemned as tuberculous by Mr Horhersall, meat inspector, who kindly sent me the carcase and organs.

were observed, but the uterus was not examined. The general condition of the cow was good. The lesions present in the calf were as follows:—

Liver.—This organ contained some hundreds of yellow tubercles, about the size of barley grains, scattered uniformly throughout the liver substance. The hepatic lymphatic glands were much enlarged, the group being about the size of a small hen's egg. The substance of the glands was mottled with caseo-necrotic streaks, in which tubercle bacilli were easily demonstrated.

Spleen.—The organ was of normal size, and its peritoneal covering was normal. Scattered throughout the splenic pulp there were about thirty firm yellow tubercles, a little larger than those in the liver.

Lungs.—The right lung contained four tubercles and the left six, each being about the size of a barley grain. The bronchial and mediastinal glands were a little enlarged, and on section they all showed white opaque specks in the cortical part of the gland.

Kidneys.—Each kidney contained a few tubercles, rather smaller than those in the liver and spleen.

Lymphatic Glands.—In addition to the hepatic, bronchial, and mediastinal groups already mentioned, two mesenteric, both right and left popliteal, and one prepectoral gland, contained tubercles, in each case about the size of common pin's heads. The brachial, pharyngeal, and precrural groups of glands appeared to be normal, as were also the pleura, peritoneum, and voluntary muscles.

Structure of the Tubercles.—The above described lesions were found, on microscopic examination, to have the usual structure, and they all contained sparing numbers of tubercle bacilli.

Case III.

That the two cases just described were instances of congenital tuberculosis is indisputable, as in each of them the calf was sacrificed only a few days after birth, at a time which clearly precluded the possibility of any of the lesions having been the result of post-natal infection. The same cannot be said of the following case, as the calf was ten weeks old when it died. The dead animal was forwarded to me by Mr A. E. Payne, M.R.C.V.S., of Hersham, Walton on Thames, together with the following history.

In the month of May last, Mr Payne was asked to examine a cow with reference to the state of her udder, and on manipulation he found that the left posterior quarter was very much larger than its fellow, indurated, and painless. The milk secreted by this quarter was very little altered in appearance. At the same time Mr Payne was informed that this cow's calf had from its birth been very unthrifty, and now appeared to be at the point of death. The calf had been fed with the milk of its dam. A few days later it died, and Mr Payne was asked to make a *post-mortem* examination of it. On opening the body he observed that the calf was extensively tuberculous, and he forwarded it to the Royal Veterinary College, with all the organs except the stomachs and intestines. The following were the lesions noted in this case:—

Liver.—Embedded in the parenchyma of this organ there were numerous caseous tubercles up to the size of a small hazel nut.

Spleen.—The peritoneal covering carried a number of flat mush-

room-shaped growth, and in the pulp of the organ there were about a dozen caseous tubercles, rather larger than peas.

Lungs.—The visceral pleura carried a number of flat growths, similar to those on the capsule of the spleen, and some were also present on the serous membrane lining the chest walls. The lung tissue showed two different kinds of lesions, viz., caseous nodules up to the size of a hazel nut, and a dense crop of tubercles scarcely so large as mustard seeds.

Lymphatic Glands.—The bronchial glands were as large as hen's eggs, and the mediastinal gland was as thick as three fingers and 5 inches in length. All these glands were extensively caseated and partially calcified. Almost the whole of the mesenteric glands were enlarged to the size of pigeon's eggs, and they also were caseous and partially calcified. Caseous tubercles were also present in the hepatic, right and left precrural and prescapular, and left axillary and popliteal. The kidneys and the lymphatic glands not mentioned appeared to be normal.

A question which must now be discussed is whether any or all of these lesions ought to be regarded as congenital in their origin. In my opinion the whole of them with the exception of the miliary tubercles in the lung tissue must be so regarded. In favour of this view stands the fact that the calf had been unthrifty from its birth, as well as the size of the tuberculous nodules in the spleen, liver, and lungs, and the partial calcification which some of them had undergone. Assuming that these lesions were due to post-natal infection, one would have to regard them as probably metastatic from a previously diseased mesenteric gland, which is equivalent to saying that they must have begun to develop some weeks after the calf's birth. But the calf was only ten weeks old when it died, and it is altogether incredible that caseous and calcified nodules up to the size of a hazel nut can develop in the course of six or seven, or even in ten, weeks. The same reasoning compels one to conclude that the "perlsucht" growths on the pleura and peritoneum were also the result of intra-uterine infection. This view of the genesis of the larger tuberculous lesions is not invalidated by the fact that the calf had been fed on tuberculous milk, although that may have been partly responsible for the condition of the mesenteric glands.[1]

The miliary tubercles in the lung tissue were evidently of much more recent date than the other lesions. Their size indicated an age of some three or four weeks, and doubtless they were the result of an irruption of tubercle bacilli into the blood stream, probably from one of the caseous mesenteric glands by way of the blood stream.

DISTRIBUTION OF THE LESIONS IN CONGENITAL TUBERCULOSIS.

Infection of the fœtus is probably always effected by way of the blood stream, the bacilli gaining access to the fœtal blood from a previously diseased placenta. In the new-born calf tuberculosis is thus generalised in the proper sense of that word, and the lesions, as a rule, have precisely the distribution which one could have predicted, given the presence of tubercle bacilli in the blood of the umbilical vein.

[1] After the calf's death Mr Payne at my request forwarded a sample of milk from the indurated quarter of the cow's udder, and tubercle bacilli were discoverable in it without any difficulty.

The liver, as the first organ to which this blood is distributed, always contains tubercles in congenital tuberculosis, and it generally contains them in greater numbers than any of the other organs. This is in marked contrast to what is observed in most cases of generalised tuberculosis in the adult animal, in which the lung tissue contains the greatest number of tubercles, owing to the fact that the irruption of bacilli generally takes place into a systemic vein, directly or by way of the thoracic duct.

In congenital tuberculosis the lungs also contain tubercles, but in relatively small numbers. Such bacilli as escape arrest in the capillaries of the liver or pass through the ductus venosus will obviously reach the right auricle by way of the posterior vena cava, but the blood discharged from this vessel is mainly directed through the foramen ovale into the left auricle, and thus misses the lungs. When tubercle bacilli gain access to the systemic veins in the adult the great majority of them are arrested in the pulmonary capillaries, and only a minority of them reach the left heart to be distributed throughout the body into the arterial blood. In the fœtus, on the other hand, the majority of the bacilli that reach the posterior vena cava are eventually carried in the arterial blood to all parts of the body. Hence arise the tubercles in the spleen, kidneys, heart-wall, and peripheral lymphatic glands.

As is well known, macroscopic tubercles are almost unknown in the spleen of the adult ox, but they are by no means rare in calves killed during the first few months of extra-uterine existence. The probable explanation is that, when the disease becomes generalised after birth, the pulmonary lesions prove fatal before such tubercles as may be developing in the spleen have had time to attain macroscopic dimensions; but in congenital tuberculosis the resulting pulmonary tubercles are not specially dangerous to life while the fœtus is *in utero* (owing to the functional inactivity of the lungs), and, owing to their relatively small numbers, the calf may even survive for some months after birth. Time is thus allowed for all the lesions to attain a far larger size in congenital tuberculosis than they ever do when generalisation occurs after birth. If this view of the matter is correct, the pea-sized tubercles met with in the spleen pulp of calves of any age ought to be ascribed to intra-uterine infection.

The distribution of the lesions of the lymphatic system in cases of congenital tuberculosis is also very different from that usually observed in adult animals. In the adult animal tubercles are very rarely present in such remote groups of glands as the popliteal and axillary, but in both of the cases of congenital tuberculosis previously described in which the lymphatic glands were examined macroscopic tubercles were present in the popliteal group, and in one of them (Case III.) the axillary, precrural, and prescapular groups were also affected. The same reasoning which explains the difference noted between the adult animal and the calf in respect of splenic tubercles would also account for the discrepancies with regard to the lesions in the remote-lying lymphatic glands.

A very interesting point in connection with Case II. is that tubercles were present in some of the mesenteric glands. They were also present in Case III., and, despite the fact that the calf had for ten weeks been fed with tuberculous milk, their partially calcified

condition warrants one in believing that the glands had been infected prior to birth. In adult life tuberculous disease of the mesenteric group of glands is generally or always the result of infection by way of the intestine, and on this account one is apt to be surprised on finding tubercles in the glands in a newly born calf. Obviously, however, there is no reason why the mesenteric glands should escape infection when there has been a general contamination of the blood stream, with consequent lesions in such groups as the axillary, prescapular, and popliteal.

The lesions in the hepatic, bronchial, and mediastinal lymphatic glands in congenital cases of the disease, unlike those in the peripheral groups of glands, are no doubt mainly the result of infection by way of the lymph stream from the organs (liver and lung) to which the groups are attached. This is indicated by the constancy with which these groups are involved in the disease. It might be said, in objection to this view, that the greater extent of the lesions in the hepatic and bronchial glands, as compared with those in such groups as the popliteal and axillary, indicates an earlier infection of the former groups. Such an objection, however, would not be well founded, for experimentation has shown[1] that, within less than a month after the irruption of tubercle bacilli into the systemic veins, the bronchial glands may have attained several times their normal size, although the other groups of glands are not appreciably enlarged. The explanation is obvious. The hæmatogenous infection of the glands is momentary, and leaves in them, as a rule, only a few bacilli, whereas the lymphatic infection of a gland from lesions in the organ to which it is attached may be repeated or almost continuous.

A study of the distribution of the lesions in cases of congenital tuberculosis affords justification for the views which I have in a previous article expressed regarding the signs of generalisation in the adult animal, viz., that the presence of tubercles in such groups of glands as the prescapular, precrural, iliac, and suprasternal, is not a proof of generalisation by the blood stream. At first sight it might appear that the contrary is the case, that there is traceable a distinct parallelism between the distribution of the lesions in congenital tuberculosis of the calf and that met with in many cases of the disease in adult animals, and that, since the congenital cases are admitted to be the result of infection by way of the blood stream, the adult cases with multiple lesions in the lymphatic glands ought also to be viewed as an example of generalised disease. Closer examination, however, shows that the parallelism is not at all a close one. Take, for example, the second of the cases of congenital tuberculosis previously described. In that case lesions of approximately the same size and character were present in the lungs, spleen, liver, and kidneys, along with tubercles in both popliteal glands, and with a normal peritoneum and pleura. Or take the third case, in which, along with lesions in the lungs, liver, and spleen, tubercles were present in the precrural and prescapular glands on both sides of the body, and in the axillary and popliteal groups on the left side. It may safely be asserted that such a distribution of the lesions is seldom or never encountered in the adult animal. It is true that in very advanced cases of disease in old cattle one not rarely finds lesions in such glands as the prescapular, precrural, and suprasternal

[1] See this Journal, Vol. XI., p. 244 *et seq.*

groups, but in such cases the lesions are as a rule manifestly of different ages, and the popliteal glands and spleen are healthy. It is impossible to imagine how such a distribution of the lesions could have been brought about by bacilli disseminated by the blood stream.

Some writers have endeavoured to draw a distinction between cases of acute and chronic generalisation, admitting that in the former an abundant crop of miliary tubercles develops in the lungs, liver, spleen, and kidneys, but contending that in cases in which there are occasional small irruptions of bacilli into the blood stream these become arrested in the various groups of lymphatic glands, and, multiplying there, excite the formation of tubercles. This is a pure hypothesis, and it is unsatisfactory both on the ground that it fails to explain the observed distribution of the lesions in natural cases, and is opposed to the results obtained by experimentation.

In the so-called cases of chronic generalised tuberculosis observed in adult animals the spleen is seldom or never affected, although when any considerable number of bacilli gain access to the arterial blood it is the organ most constantly involved in the disease. This is most clearly seen in cases of intra-uterine infection. It is doubtless equally true of post-natal infection, but it escapes observation because (1) in many cases of generalisation occurring in the adult only a small proportion of bacilli escape arrest in the pulmonary capillaries, and (2) because generalised tuberculosis of the adult animal is almost invariably fatal in consequence of the pulmonary lesions before the tubercles in the spleen have had time to attain macroscopic dimensions.

No hypothesis framed to account for the lymphatic lesions observed in advanced cases of tuberculosis in adult cattle can be accepted unless it explains this exemption of the spleen. The suggestion that when only a few bacilli are at intervals thrown into the blood stream a larger proportion reach the left side of the heart than when a greater number suddenly gain access to the circulation, may be dismissed as altogether improbable and meanwhile entirely unsupported by experimental evidence. The spleen is usually free from tuberculous lesions in old animals simply because tubercle bacilli rarely gain access to the arterial blood during adult life.

It is very easy to reproduce experimentally in the rabbit the distribution of lesions observed in acute generalised tuberculosis and in the so-called chronic generalisation in the ox. The first is obtainable by injecting tubercle bacilli into one of the auricular veins, and the second by subcutaneous inoculation on the abdominal wall or thigh. In the former case the animal will die with tubercles in the lungs, liver, spleen, and kidneys; in the latter it may be killed at a stage when the lymphatic glands on both sides of the body are more or less extensively diseased although the spleen is quite free from tubercles.

EDITORIAL ARTICLES.

VETERINARY INSPECTION OF MILCH COWS.

THE recent Order of the Local Government Board giving Public Health Authorities power to prohibit the sale of milk from cows affected with tuberculous disease of the udder has given fresh importance to the question of veterinary inspection of dairies and the means by which tuberculous mastitis may be diagnosed in the living animal. It is gratifying to learn that in several boroughs arrangements for a periodic inspection of all the dairy cows within the boundaries by a qualified veterinary surgeon have already been made, with a view to the detection and elimination of cases of tuberculous disease of the udder. This is, no doubt, a step far short of what many people have demanded, and we have already expressed the opinion that more extended powers are necessary to enable large towns which draw their milk supply mainly from outside sources to prevent the sale of unwholesome milk. Nevertheless, if full advantage is taken of the new Order the sale of milk from cows affected with mammary tuberculosis may be made much more difficult than it has been hitherto.

The first question which arises in connection with the exercise of the powers conferred by the new Order is, how frequently is it necessary to have the udders of milch cows inspected in order to guard against the sale of tuberculous milk? This is a question not easy to answer. It may safely be asserted that the shorter the intervals between the inspections the better, but a limit to the frequency of inspection is placed by the expense thereby incurred. On this account it would be useless to recommend inspection at shorter intervals than a fortnight, and at first many authorities will probably be content with less frequent examinations, but if any substantial benefit is to be obtained from the exercise of the powers conferred by the Order the interval between the inspections should certainly not exceed one month. In this connection it must be remembered that no obligation to report cases of tuberculous disease of the udder is laid upon the owner of cows, and that no penalty for the sale of tuberculous milk can be inflicted so long as the sale has not been prohibited on the certificate of a veterinary inspector to the effect that the animal in question is affected with tuberculous disease of the udder. Had notification been made compulsory, and the sale of milk from a cow with a visibly diseased udder been forbidden

under a penalty, there would have been less occasion to insist upon a frequent veterinary inspection of dairy cows.

The second question arising out of the new Order relates to the means by which tuberculous disease of the cow's udder may be diagnosed while the animal is still alive. According to our present knowledge the characters which serve to broadly distinguish tuberculous mastitis from other diseased conditions of the udder are: (1) that it is always insidious in its onset, (2) that its course is always chronic, (3) that it never ends in resolution, (4) that it steadily adds to the volume and density of the invaded quarter, and (5) that at the outset of an attack the milk is not notably altered either in quantity or appearance.

It has been stated that tuberculous disease of the udder has sometimes a comparatively sudden development, and a semi-acute course. This is probably an error if it implies that a previously healthy gland may within a few days develop a tuberculous lesion so gross as to be readily detected by manipulation. There is no reason to suppose that tuberculous disease proceeds with much greater rapidity in the udder than in other organs such as the lung or a lymphatic gland, and both natural and experimental cases teach that a period of weeks rather than days elapses between the infection of an organ and the development of macroscopic lesions in it.

The insidious onset of tuberculous mastitis is a character valuable for diagnosis, and at the same time one which renders the disease peculiarly dangerous. When a reliable clinical history is obtainable to the effect that within the course of a day or two a previously healthy quarter has become considerably enlarged, and when this enlargement is associated with the usual signs of acute inflammation—an abnormally high surface temperature, congestion of the superficial vessels, and tenderness on pressure—it may safely be concluded that the lesion is not of a tuberculous nature. By this means a great many cases of udder disease can immediately be dismissed when only tuberculous mastitis is being sought for.

The commonly occurring non-tuberculous cases of mastitis develop rapidly with the before-mentioned accompaniments of acute inflammation, and in the great majority of such cases the affected quarter begins to shrink as the acute inflammatory phenomena subside. This is also a very valuable point for diagnosis, and it enables one to put aside all those cases in which a cow has only three active quarters, with a fourth which yields little or no milk and is abnormally small in size. On the other hand, a quarter that is larger than its fellow of the opposite side, and indurated without tenderness, must always be provisionally diagnosed as tuberculous.

Stress has, by some authors, been laid on the condition of the supramammary lymphatic glands as a guide to diagnosis, but, as a rule, in actual practice very little information is derivable from that source.

In the early stages of lactation in cows with large fleshy udders it is often quite impossible to ascertain the condition of these glands, and they may escape detection even when they are considerably enlarged. Besides that, the glands are generally more or less enlarged in all forms of inflammation of the udder, at least while the disease is in an active stage.

A less constant character of tuberculosis of the udder than those previously noted is invasion of the quarter from above downwards. The great majority of acute inflammations of the gland begin around the milk cistern, at the lower part of the quarter, but the whole quarter speedily becomes involved, and at the time when such cases come under observation it is impossible to trace how the disease began. On the other hand, one often encounters cases of tuberculous mastitis with marked enlargement and induration at the upper part of the quarter while a portion of the gland over the base of the teat is still of the normal size and flaccidity. It is true, however, that tuberculous disease of the udder sometimes appears to begin at the lower part of the quarter.

The character of the induration in tuberculous mastitis deserves special attention. The nodular character of tuberculous lesions in the other organs commonly affected, such as the lungs, liver, and serous membranes, is apt to lead one to expect a similar condition in tuberculosis of the udder. As a matter of fact, however, the disease in the udder is seldom tuberculous in the anatomical sense, for instead of a number of well defined nodules or tubercles embedded in comparatively sound gland tissue one usually finds a single diffuse indurated area shading gradually into the surrounding flaccid tissue of the udder.

A negative characteristic of tuberculosis of the udder which is of some value for diagnosis is that the lesion has little or no tendency to soften, and seldom or never bursts spontaneously through the skin. On the contrary, the lesion generally becomes firmer with age, and sometimes acquires an almost stony hardness from calcification.

In the generality of non-tuberculous inflammations of the udder, and always in those of an acute character, the milk is from the outset profoundly altered in character and amount. It is usually purulent, curdy, or ropy in consistence, and frequently it is more or less deeply tinged with blood. The amount of secretion that can be drawn off through the teat is always diminished. In tuberculosis of the udder, on the other hand, the lacteal secretion may not be sensibly altered in appearance or quantity at a time when the lesion has attained considerable dimensions and is easily detectable by manipulation. In the later stages, however, when the greater part of the quarter has become involved in the disease, the secretion is greatly diminished in amount and quite abnormal in appearance. Such liquid as can then be drawn off is generally whey-like in

colour, and on standing it deposits a considerable amount of sediment. It ought to be observed, however, that similar appearances may be presented by the milk in the late stages of the acute non-tuberculous inflammations.

Probably the most constant of the characteristics of tuberculous disease of the udder is the presence of tubercle bacilli in the milk of the affected quarter. Unfortunately, this character is of less value for clinical diagnosis than it might at first sight appear to be. It is only exceptionally that the bacilli occur in the milk in such numbers as to make it practically impossible to overlook their presence when a properly prepared cover-glass preparation is examined with a suitable microscope, and if it were made a rule that the disease must not be diagnosed except when tubercle bacilli can be demonstrated microscopically in the milk condemnation would in many cases have to be dangerously delayed. Nevertheless, in every case in which the clinical characters of the udder disease raise a suspicion of the lesion being tuberculous the milk ought to be microscopically examined. Ought such examination to be undertaken by the veterinary surgeon? The answer to that is that there is no reason why he should not, provided he has by practice assured himself of his ability to detect tubercle bacilli in any product in which they are present in considerable numbers. He must be equipped with a good bacteriological microscope, comprising an oil-immersion lens, and magnifying 800 diameters. Any slaughter-house will provide him with abundance of material on which he may exercise himself in staining tubercle bacilli by the Ziehl-Nielsen or other approved method, and detecting them with the microscope. When he has confidently mastered the technique of this process he need not hesitate to apply the same methods to the discovery of tubercle bacilli in milk.

During the advanced stage of tuberculous mastitis, when the milk has become markedly altered in appearance, a competent person will seldom fail to detect the bacilli in the first few cover-glass preparations examined. At this stage the milk on standing generally deposits a considerable amount of sediment rich in leucocytes and other cells from the udder, and this is the material that ought to be selected for microscopic examination. As long as the milk furnished by the suspected quarter is comparatively normal in appearance and quantity it is a great advantage to have a small centrifugal machine, by means of which the cream may quickly be obtained from a sample of milk and any solid particles in it that tend to precipitate may with equal rapidity be thrown down. It has been stated by some observers that in centrifugalised or separated milk the bacilli are mainly or entirely found in the thin milk or in the sediment. This is certainly not the case when the milk is still normal in appearance and fairly rich in cream, for the bacilli are then carried up in considerable numbers with the milk globules, and are often more readily found in the cream

than in the remainder of the sample. Probably the safest plan is to stain preparations from both the cream and the sediment. In the absence of a centrifugal machine the sample of milk to be examined may be allowed to stand for twelve hours or more in a conical glass vessel, until the cream has risen and any solid particles have fallen to the bottom.

When tubercle bacilli are found in milk that has been taken with precautions that exclude the risk of accidental infection no room is left for doubt as to the diseased condition of the udder, but it must not for a moment be supposed that failure to detect tubercle bacilli with the microscope, even when the search has been a prolonged one, justifies one in concluding that the udder is not tuberculous, or that tubercle bacilli are not present in the milk. One may add tubercle bacilli to milk and then dilute it to such a degree as to make the detection of the bacilli in it with the microscope almost impossible except by spending an unreasonable amount of time in the search. Nevertheless, such diluted milk remains infective if used in sufficient quantity, and although the danger is no doubt less in proportion to the degree of dilution one cannot admit that milk is fit for human food when it contains only a few tubercle bacilli.

The considerations just referred to raise an important question, viz., what is the duty of a veterinary inspector entrusted with the powers conferred by the recent Order of the Local Government Board when in the case of a cow with an enlarged, indurated, and painless quarter he is unable to demonstrate the presence of tubercle bacilli in the milk? We think that he ought not to hesitate to diagnose tuberculosis of the udder in such circumstances, and by so doing give the human consumer of the milk, rather than the cow, the benefit of the doubt. In such a case, however, the diagnosis and the suspension of the milk may be made provisional, until the cow can be tested with tuberculin, or until the milk can be tested by experimental inoculation. It may be objected that the tuberculin test cannot be employed to determine whether a given lesion of the udder is tuberculous or not, since a reaction merely indicates that there is tuberculous disease in some part of the animal's body. In spite, however, of the force which lies in this objection, it is worth while to employ the test in doubtful cases of this kind, for, in the first place, it may show that the animal is not tuberculous anywhere, and thus remove the suspicion that attached to the udder, and, in the second place, in the event of a reaction being obtained in a cow whose udder is clinically tuberculous, the fact must be allowed some weight in considering whether the animal ought to be condemned for milk purposes.

In all cases that remain doubtful after clinical and microscopical examination inoculation experiments may be employed, the use of the milk being in the meantime suspended. This is beyond any

doubt the most delicate test for the presence of tubercle bacilli in milk, but little need be said with regard to it here, since experiments of this kind are illegal on the part of those who do not possess a vivisection licence, and because for their successful employment facilities which are not usually at the command of the ordinary practitioner are required.

There is, however, one point connected with the testing of milk by inoculation experiments to which it is fitting to call attention here—namely, the necessity of collecting the sample to be tested in such a way as will avert the chance of error from accidental contamination of the milk with tubercle bacilli after it has left the cow's udder. With this object it is necessary to cleanse and disinfect the teat and the hand used for milking, and to collect the milk in a clean, sterile bottle. In this connection it may be observed that when milk taken as it leaves the farm or dairy is found to be infective by the delicate test of experimental inoculation, it does not follow that the herd of cows furnishing the milk in question contains an animal with tuberculous disease of the udder. The sediment which common market milk too frequently deposits on standing is mainly composed of excrement and other dirt from the cow's udder or from the air of the cowshed, and matter of that kind derived from premises containing a large proportion of tuberculous cows may add tubercle bacilli to milk that is quite wholesome as it leaves the gland.

TAINTING OF PASTURE: WHAT IS IT?

It is a fact well known to sheep-breeders that land which is continuously employed for the feeding of sheep is apt to become unwholesome for animals of that species, although it may be in no way hurtful to horses or cattle. Analogous observations have been made regarding pasture devoted exclusively to the grazing of horses, or employed as poultry runs. To denote this unwholesome quality of land farmers usually employ such expressions as "stained," "tainted," and "sour," and as a rule they attribute the losses which occur among animals kept on such land to some manurial effect entailing an improper composition of the grass or roots grown on the polluted ground. This tendency to ascribe disease among farm animals to injurious substances incorporated in the growing plants is very common both among stock-owners and veterinary surgeons, but when one comes to examine the evidence in support of the opinion it is found to be very far from conclusive. Indeed, one may go further, and assert that there is no evidence at all in favour of the view that apparently sound herbage or root-crops ever cause disease in animals in consequence of some abnormality in their composition traceable to chemical substances in the soil. This statement applies equally

to the alleged unwholesome character of crops forced by artificial or natural manures, and to pasture that has been overstocked.

There is nothing in the least mysterious about the unwholesome character which land is apt to acquire for a particular species, when for a long period animals of that species have been kept on it in large numbers. The losses which occur in such a case are generally determined by animal parasites, and most frequently by such of these as inhabit the alimentary canal. Over-stocking and continuous grazing of pasture by the same species favour the development of parasitic diseases, and indeed, to the uninitiated, they appear to actually engender the parasites themselves. Take, for example, a comparatively common experience with sheep. A particular farm may for a long time have deservedly had a high reputation as a healthy one for sheep, but by a liberal use of artificial foods and manures the stock is considerably increased, and within the course of a few years the losses from disease and death may have become very serious. Investigation in such a case will probably show that the losses are attributable to quite a number of different parasites, such as the strongylus filaria and the strongylus rufescens in the lungs, the strongylus contortus and other species of round worms in the stomach, tape-worms in the small intestine, and the trichocephalus affinis in the large bowel. All these parasites have one common point in their life-history—viz., that they have not, like the pathogenic bacteria, practically indefinite powers of multiplication within the animal body, but require to pass a stage of their existence in the outer world. A few individuals of any of these species will not suffice to set up serious disease, because either the eggs or the embryos that come into existence within the sheep cannot themselves attain to maturity and multiply until they have succeeded in effecting a change of host. The eggs or embryos must leave the body of the animal in which they have been bred, and run their chance of re-entering the same or another sheep. Obviously the greater the number of sheep kept in a given area the better will be the opportunities for such re-entrance. Obviously, also, continuous occupation of the same ground by sheep will have a similar tendency, and when both of these factors—over-stocking and continuous occupation—are in operation a time may soon arrive when a great many members of the flock will have taken into their bodies a sufficient number of parasites to cause serious disturbance. This untoward result would, of course, not ensue if the flock to begin with were absolutely free from the parasites in question, but *post-mortem* examination of what are called healthy sheep teaches that the presence of a few such parasites is the rule rather than the exception. Hence it may be said that the seeds of dangerous disease are constantly present, and always ready to take advantage of the circumstances favourable to their multiplication. It will thus be seen that in the pollution of ground the

excrement of animals generally plays a very important part, not because of any effect which it has on plant growth, but because it is the medium by which many harmful parasites are added to the soil.

Somewhat related to this subject is the question of sewage contamination of water and pasture as a cause of disease in the domesticated animals. Sewage—by which is generally meant water carrying a large proportion of human excrement—has frequently been accused of causing disease in animals, but, as a rule, in such cases there is a lack of precision in the indictment. If sewage is harmful to animals, what is the precise nature of the disease which it induces? It is not sufficient to say in answer to this question that animals drinking sewage-polluted water or eating grass grown on sewage-irrigated land frequently become unthrifty, or that the death-rate among such animals has often been observed to be high. One is entitled to demand information as to the precise etiological factor in the sewage. That water contaminated with human excrement is dangerous to human beings admits of no denial, but it does not follow that this danger extends to horses, cattle, and sheep. As a matter of fact, sewage is dangerous to human beings chiefly because of the germs of cholera and typhoid fever which it often contains, but neither of these diseases is communicable to any of the farm animals.

It is true that human fæces may infect pigs with the cysticercus of the tænia solium, or the ox with the cysticercus of the tænia mediocanellata, but this is not what is usually meant when charges of causing illness among animals are brought against sewage. The fact appears to be that there are no solid grounds for believing that disease on a large scale has ever been caused among the lower animals by sewage contamination of either grass or water, and the alleged transmission of disease to human beings by means of the milk of cows drinking polluted water or eating grass grown on a sewage farm is equally groundless.

Reviews.

Annual Reports of Proceedings under the Diseases of Animals Acts, the Markets and Fairs (weighing of cattle) Acts, etc., for the Year 1898.

THE first of the Reports included under the above heading is from the pen of Mr Cope, the Chief Veterinary Officer to the Board, and it deals with the various contagious diseases of the domesticated animals against which the provisions of the Diseases of Animals Acts are mainly directed. It opens with an interesting historical account of the three animal plagues from which, thanks to the operations of the Board of Agriculture, the cattle of this country at present enjoy a complete immunity, viz., cattle-plague, foot-and-mouth disease, and pleuro-pneumonia. It is very gratifying to learn that only one case of the last-named disease was detected in Great Britain in 1898, and the period which has elapsed since that case occurred warrants a very confident hope that the disease has at last been completely eradicated. This result was secured by placing special restrictions on the movement of cattle kept in the London cowsheds.

In the Report for the year 1897, reference was made to the fact that while pleuro-pneumonia had been stamped out in the county districts, outbreaks still continued to be reported in the cowsheds in the east end of London, and it had become evident that unless some supervision was maintained over, and strict inquiry made into, the sanitary condition of the cattle therein, it would never be known whether the disease had ceased to exist. With this object in view an Order was passed prohibiting the movement of cattle out of these cowsheds except with a licence, so that the lungs of each animal could be carefully examined by a veterinary surgeon to discover whether any recent or old standing cases were still remaining.

The cow-keepers whose interests were seriously affected by this Order expressed strong objections to the action taken by the Board, but when it was pointed out to them that the Order was only of a temporary character and would be withdrawn as soon as possible, having a due regard to the object for which it was framed, and that the results must eventually be of a permanent and lasting benefit not only to them, but to every stock-owner throughout the United Kingdom, they withdrew their opposition.

The Order included a district in the east end of London containing 233 cowsheds, in which it was ascertained there were no fewer than 2742 cows at the time when it came into force. This extensive area was divided into three districts, each being placed in the charge of a veterinary surgeon whose duties consisted in granting licences for the removal of cows for slaughter, attending the *post-mortem* examinations, and bringing to the laboratory of the Board any lungs which, in their opinion, were affected with, or suspected of, pleuro-pneumonia. At the time when they commenced their inquiries the inspectors appointed reported that all the cattle in the sheds, with few exceptions, were a fine healthy-looking lot, and presented no clinical evidence of disease in their lungs.

The Order remained in force for a period of ten months, during which period 2052 of the 2742 cattle which were in the sheds at the time when the examination commenced were slaughtered, and as a result of the *post-mortem* examinations conducted by the veterinary surgeons, five cases of pleuro-pneumonia were detected, chiefly in the old and encysted form.

It is now fifty-seven years since pleuro-pneumonia was first recognised in this country, and Mr Cope estimates that during that period no fewer than 127,222 animals fell victims to the disease. The final extermination of a disease which can occasion such serious losses to the agriculturist is an event that justifies some pride on the part of those who designed and carried into execution the measures that proved successful.

It is matter for regret that the experience of 1898 with regard to another important animal plague, viz., swine-fever, does not justify any great laudation of the efforts of the Board, or hold out strong hopes that the disease will in the near future suffer the fate of cattle-plague, foot-and-mouth disease, and pleuro-pneumonia. The part of Mr Cope's report which deals with this subject is pitched in a somewhat apologetic tone, as it well may be, in face of the fact that the outbreaks of swine-fever reported in 1898 numbered 2514, as against 2155 in 1897. Those who are interested in the subject are reminded, perhaps a little late in the day, that "swine-fever has never yet been eradicated from any country in the world where it has become widely spread and obtained a good foothold." It is to be hoped that this does not foreshadow a confession that the Board consider the eradication of the disease from this country an impossibility.

The Assistant Secretary of the Animals' Division of the Board contributes a report containing a large amount of interesting information regarding the trade in foreign animals, losses incidental to transit by sea and land, etc., and the volume concludes with the usual statistical tables showing the incidence of the various diseases dealt with by the Board.

Practice of Equine Medicine. A Manual for Students and Practitioners of Veterinary Medicine, arranged with questions and answers. By Harry D. Hanson, D.V.S., Associate Professor of Theory and Practice of Clinical Veterinary Medicine in the American Veterinary College, New York, etc., etc. New York: H. D. Hanson and Brother, 1899.

It is possible that this book will commend itself to students preparing for examination in the United States of America, for it professes to teach within a comparatively brief compass the proper answers to a large number of questions touching the diseases of the horse. It is modelled on the "cram" system, and possibly it supplies a "felt want," but cramming is not teaching, and we must candidly confess that Mr Hanson's manual is not one that a good teacher would like to see in the hands of his students. In very many cases the answer which it supplies to its own question is open to the two-fold fault of being incomplete and inaccurate. To illustrate its defects we shall cite one or two examples.

In answer to the question, What is the ætiology of cirrhosis of the liver? it is stated that the "condition is associated with chronic heart disease and diseases of the lungs, which produces a constant venous congestion of the liver, causing the central cells of the liver lobules to atrophy from an increase of the connective tissue which takes place." This, of course, is erroneous, and it almost looks as if the author had supposed that cirrhosis is a synonym for nutmeg liver. In connection with the same subject it is said that the liver is usually smaller, but, at least in Europe, cirrhosis of the horse's liver is generally associated with enlargement of the organ.

Under the head of strangles, it is said that the disease "is now placed among the germ diseases, although the exact nature of the germ is not well understood." Happy American veterinary student, who lives on a continent where nothing is known to the examiners about the strangles streptococcus!

CLINICAL ARTICLES.

A PRELIMINARY NOTE ON THE SPAYING OF COWS.

By FRED. HOBDAY, F.R.C.V.S., Royal Veterinary College, London.

THE spaying of cows has been practised more or less at intervals for many years with varying results (Bartholin, Winn, Charlier, Gamgee, and others), but the subject is of especial interest just now to the agricultural and dairying committees, as well as to the veterinary profession, owing to the recently published researches of M. Flocard, Veterinary Surgeon, of Geneva.

This gentleman published an article on the subject in 1895,[1] and more recently, through the medium of M. Chauveau, presented an article to the notice of the Société Nationale d'Agriculture de France,[2] which appears to show that the greatest pecuniary benefit has resulted from the operation.

It is stated in the paper that animals which are being prepared for the butcher are fattened in a much shorter time, and that the flesh is better in quality than that of the uncastrated cow, the yield in actual meat being about 6 per cent. more. The flesh, even of an old cow, is said to become as palatable as that of the steer.

With milking cows the advantages are very marked for the dairyman whose practice is to buy in cows which have just calved and sell them when the milk yield falls below a paying point. For the breeder, of course, the question is not worthy of so much consideration. A most remarkable effect is noticed upon the milk yield, the duration of lactation being prolonged for an average of from twenty to twenty-four months. It has been known to continue as long as three, four, and even five years, the amount given during the major part of this time being as much, or almost as much, as within a few weeks after calving. On account of the absence of œstrum the quantity is regular the whole of the time, this fact alone giving a large increase in the yearly output; the richness of the milk is said to be increased, especially for butter-making purposes.

In a very courteous letter which I received from M. Flocard about three weeks ago, that gentleman confirmed the value of the operation for dairy or fat stock, and stated that during the past twenty-two years he had performed 5079 ovariotomies in cattle. The percentage of fatalities in the first 2000 was about ·5, while a further 6 per cent. of secondary complications ensued. In the last 3000 no fatalities have occurred, and there have only been four or five secondary acci-

[1] Bulletin de la Classe d'Agriculture de la Société des Arts de Geneva. 1er trimestre, 1895, No. 141.

[2] Bulletin des Séances de la Société Nationale d'Agriculture de France. Janvier, 1898.

dents of very minor importance. He attributes the successful results to the observance of rigid antiseptic precautions and to care in the manner of operating. This latter is done *per vaginam* in a manner similar to that ascribed to Charlier,[1] but with certain improved instruments and improved methods of application.

In October last M. Flocard came to England and spayed forty-two cows of mixed breeds (chiefly cross-bred Shorthorns) belonging to a large dairy-owner in Kent, and since then this latter gentleman has been very keenly interested in tracing up the result, especially with regard to its effect on the milk supply. Sufficient time has not yet elapsed to give a final opinion, and the effect was somewhat lessened by the fact of many of the cows having been too long past the period of calving to be in full milk. However, on the 26th of May last, I received a letter from which I quote the following: "They (the cows) have certainly kept their average up better than usual and fattened much quicker than they do as a rule, and I consider that this is due to the operation. . . . I believe the operation answers for men who carry on their business in the same manner as myself, *i.e.*, to buy in fresh cows and sell out fat."

I have been able from time to time to watch this herd, and also to compare them with others under similar conditions, the results so far appearing most decidedly in favour of the spayed cows.

I propose to return to this at a later date, as the main object of this preliminary article is to describe the operation and its immediate effects upon some eight cases in which I have had opportunities of performing it.

The best time at which to operate is about five or six weeks after calving, the animal then usually giving her maximum quantity of milk. For cattle that have aborted and have a prospect of doing the same again, for those liable to trouble at or about the time of parturition, for cows whose age makes it undesirable to breed from them again, and for those suffering from some disease (such as tuberculosis, nymphomania, etc.) which makes it desirable that they shall be fattened for the butcher, and in the case of certain dairy herds kept in large towns, the operation is one well worthy of consideration.

The operation is by no means difficult, the instruments needed being an écraseur with a specially long handle (M. Flocard has a pattern of his own) and a knife somewhat like one of the English patterns of embryotomy knife with a protected or hidden blade. The cow is starved for about twelve hours in order to get the intestines fairly empty, and is tied up in the ordinary way in a stall, the tail and hind parts being carefully cleansed. Bull-dogs are applied to the nose, and, if necessary, a kicking strap or rope secures the hind limbs. The vagina is syringed thoroughly with some antiseptic solution, which is left in contact with the mucous membrane for at least ten minutes; the antiseptic is then removed with clean wadding, and the vagina is wiped out.

The instruments having been sterilised by boiling and the hands of the operator thoroughly soaked or scrubbed in some antiseptic, the knife is taken in the right hand and introduced into the vagina; the blade is pushed out and a puncture made in the central line of the vaginal wall, about an inch above the os uteri, the blade being

[1] Précis de Chirurgie Vétérinaire (Peuch and Toussaint), Vol. I., page 670.

again ensheathed and the knife dropped on the vaginal floor. The opening is enlarged by tearing until it will admit of the passage of the fore and middle fingers or (if thought necessary) of the whole hand. A search is made just inside the orifice in a downward direction, the ovary being quite easily found, feeling like a smooth marble or walnut. By a little manipulation first one and then the other is drawn through the orifice into the vagina, the écraseur chain being passed round each in turn and the handle slowly twisted. The ovaries are both removed from where they have fallen on the vaginal floor and the operation is finished.

After-treatment consists merely in keeping the external genitals and tail clean for a week or ten days. As a rule the cow commences to eat as soon as food is offered, and the operation does not appear to cause any more pain than the operation of castration in the colt. Care must be taken when making the vaginal puncture to plunge the knife blade straight and not in the direction of the bladder, the posterior aorta, the iliac arteries, or the kidneys.

The following are recent cases in which the operation has been done; the knife used was a French pattern and the écraseur a large Chassaignac.

CASE I.—Shorthorn, seven years old, in fair condition, which had aborted some months before.

Oöphorectomy was performed on the 15th of October 1898 with a view to causing her to fatten quicker. The flow of milk diminished in quantity during the next twenty-four hours, but then returned again to the normal amount. There was nothing further worthy of remark; in the owner's opinion the animal fattened decidedly more quickly than he would have expected had she not been spayed, and she was sold and lost sight of in December.

CASE II.—Cross-bred Shorthorn, five years old, in poor condition, which had calved about five weeks before (20th January 1899).

11th March 1899. Oöphorectomy. I had some little difficulty in securing the right ovary, and the animal had a diminished milk supply for two or three days, but eventually did well.

CASE III.—Cross-bred Shorthorn, nine years old, which had calved 3rd February 1899.

11th March. Oöphorectomy. For about a week or ten days later this animal seemed to have a little trouble when urinating, but this ultimately passed off.

CASE IV.—Cross-bred Shorthorn and Ayrshire, aged, in poor condition, calved six weeks ago.

CASE V.—Shorthorn, about four years old, in fair condition, calved six weeks ago.

Oöphorectomy was performed in each case on 15th April 1899. They both did well, there being nothing connected with the operation worthy of remark.

CASE VI.—Shorthorn, six years, good condition, a very good butter-making cow, the milk having a distinct yellow tinge, but the animal had unfortunately lost a quarter from mastitis. The operation was performed on the 29th of April, and recovery was uneventful.

CASES VII. and VIII.—Shorthorn, aged, and a cross-bred Shorthorn and Ayrshire, about seven or eight years. Each had calved about six weeks before.

Oöphorectomy was performed on 4th May. Case VII. made an uneventful recovery, but Case VIII. appeared very dull on the 5th, 6th, and 7th, eventually, however, making a good recovery.

The above is a brief resumé of the operative part of the procedure in the eight cases, and it is as yet too early to form any opinion regarding them for the amount of milk or the progress of fattening (except in Case I.) I hope, however, with the kindly promised collaboration of Mr Fraser, F.R.C.V.S., Mr Wallis, M.R.C.V.S., Mr Purrott and Mr Kirby (Members of the Royal Agricultural Society to deal with them at a later date.

Analyses of the milk both before and after are being made by Dr Voelcker with the idea of determining the effect upon the quality.

DIFFICULTIES IN THE DIAGNOSIS OF ANTHRAX.

By J. M'FADYEAN, Royal Veterinary College, London.

IN anthrax of cattle, sheep, and horses the blood everywhere at the time of death contains the characteristic bacilli in such numbers that their presence can scarcely be overlooked, and when an opportunity to examine the fresh blood of a carcase is presented the diagnosis of this disease is, therefore, very easy. On the other hand, it is often far from easy, and sometimes impossible, to diagnose anthrax from microscopic examination when putrefaction has made considerable progress in the carcase before it is submitted for examination, owing to the fact that the anthrax bacilli die and disintegrate as the blood is invaded by putrefactive bacteria. In a proportion of the cases in which parts are sent to me for microscopic examination on account of suspected anthrax, no opinion can be offered, owing to the fact that the material sent is more or less putrid, but cases of this kind are relatively fewer since it has become the custom to send an ear or a foot of the suspected animal in preference to the spleen or some other internal organ. The following cases are somewhat unusual, and show that diagnosis may be attended with difficulty even when the parts sent for examination are not sensibly putrid.

Case I.

On 29th January last a pig's ear was received at the laboratory with the request that the blood in it might be examined for anthrax bacilli. A microscopic examination failed to reveal any of these germs. On the 31st one of the feet of another pig that had died at the same place was forwarded for examination, and the result was again negative. On 2nd January a dead guinea-pig (A), which had been inoculated from the carcase of a suspected pig four days previously, was forwarded. Dissection of this guinea-pig showed a large inflammatory lesion at the place where it had been inoculated with pig's blood, and microscopic examination of the inflammatory exudate showed immense numbers of small ovoid bacteria of the fowl cholera type, but no anthrax bacilli. The spleen of the guinea-pig was not notably enlarged, but a few distinct anthrax rods were detected in its pulp, along with many small bacteria similar to those

present at the seat of inoculation. The spleen pulp also contained many pale-staining scarcely recognisable anthrax rods, evidently dead and disintegrating. By inoculation of appropriate media both the anthrax bacilli and the smaller ovoid organisms were obtained in artificial culture.

On 3rd February all the blood that could be obtained from the pig's foot, examined for anthrax bacilli with negative result on 29th January, was collected and injected under the skin of a guinea-pig (B). The result of this experiment was negative, the animal being apparently unaffected by the inoculation.

On 2nd February a guinea-pig (C) was inoculated with a trace of liquid from the seat of inoculation in guinea-pig A. It died on 13th February, and its dissection showed a large inflammatory swelling at the place where it had been inoculated, with very numerous small ovoid bacteria in the exudate, but no anthrax bacilli. The blood of the spleen pulp showed no bacteria of any kind. Tubes inoculated from the local inflammatory swelling yielded an abundant pure growth of small ovoid bacteria, but others inoculated from the spleen and blood remained sterile.

The correct interpretation of these results is probably as follows: Guinea-pig A was inoculated on 29th January with blood from a pig found dead that morning, and it died from a mixed infection, either owing to the operation having been performed with dirty instruments, or because, although only a few hours had elapsed since the pig's death, its blood had already become invaded by putrefactive organisms, including the small ovoid bacteria.

Guinea-pig B was inoculated from the foot of the same pig as that whose blood was used to infect guinea-pig A, but it remained unaffected, probably because any bacilli present in the blood of the pig's foot at the time of death had undergone degeneration and death in the five days which elapsed before the blood was used for inoculation.

Guinea-pig C was inoculated with material known to contain two species of organisms, viz., a few anthrax bacilli, and numerous small ovoid bacteria. It died from the effects of the latter only, because the anthrax rods visible in the material used for inoculation had already lost their vitality or were too few in number to infect.

Case II.

On 30th June a sheep's ear and spleen were received at the laboratory for microscopic examination, in order to determine whether the animal had died from anthrax or not. The sheep had been subjected to a *post-mortem* examination on the previous day, about twelve or fourteen hours after death. Microscopic examination of blood from the ear showed large numbers of anthrax bacilli, but a preparation made from the spleen pulp, when stained with methylene blue, appeared to be surprisingly (in the circumstances) free from bacteria of any kind. Attentive examination showed, however, numerous granules stained of a faint violet colour; and here and there the outline of an almost colourless rod, agreeing in size and shape with an anthrax bacillus, could be made out. These were taken to be anthrax bacilli on, the point of dissolution, and the faintly violet

granules were regarded as the remains of other bacilli of the same kind.

In order to ascertain whether the splenic bacilli were actually dead or not, a quantity of spleen pulp was shaken up with about twenty times its volume of sterile water, and half a cubic centimetre of the mixture was injected under the skin of a rabbit. As a control experiment another rabbit was inoculated by scarification of its ear and rubbing in of a trace of blood from the ear of the sheep. The latter rabbit died from anthrax on the third day, but the one inoculated from the spleen pulp remained unaffected.

The case is illustrative of the tendency of anthrax bacilli in the deeper parts of the body to die and disintegrate after the animal's death, but a remarkable point is that the disappearance of the bacilli was not in this case due to an invasion of the body by putrefactive bacteria, for the spleen had no odour of putrefaction, and on microscopic examination appeared to be almost free from bacteria of any kind.

INTRA-CRANIAL STRANGLES ABSCESS IN A MARE.

By H. CAULTON REEKS, M.R.C.V.S., Spalding.

THIS case, from two or three points an interesting one to me, I thought might prove of interest to others. Hence this short report.

Date.—February 13th. *Time.*—10.30 A.M.

Subject.—A five years old, in foal, brown cart mare, in good condition.

History.—This was furnished by the messenger, who told me that the mare was down on the floor, breathing heavily, and unable to rise. She had not been noticed ill before to-day, but the other animals in the stable were all suffering from strangles. The owner had been treating them himself, and until that morning they had all been doing well. Further questioning elicited the fact that this particular mare had not been noticed to ail at all; she was in reality the only one in the stable which had escaped the disease.

Needless to say, I immediately hurried off, armed with instruments and a tracheotomy tube, and fully prepared to find the animal in the last stages of dyspnœa from a deep-seated strangles abscess.

Symptoms.—I found the mare again on her legs, and a rapid glance told me at once that my first surmises were wrong. She was standing with her eyes half closed and her neck lowered, allowing the manger to take the whole weight of her head, at times leaning or pressing against the wall. The throat showed no signs of enlargement whatever, and the respirations, twelve in number, were perfectly normal. The mucous membrane of the eyelids was healthy in colour. The eyes were bright but non-intelligent, and the pupil was dilated to its fullest extent. The pulse was forty, full and firm, and the temperature 101·4°. Ears and extremities cold.

I had her haltered, and attempted to make her move. This she

could do with difficulty, and showed rather a tendency to back. On my insisting on it she partly turned, but reeled and staggered to such an extent as to render further efforts dangerous to myself.

During this disturbance her breathing became heavy and laboured, and took place largely through the mouth.

Here the owner appeared and informed me that the mare was out on the 11th (two days ago) for a short distance, and with only a light load. He remembered the carter remarking that there was considerable difficulty in getting the mare home again. She recovered, however, and appeared quite well until she had eaten her breakfast at 7.30 this morning.

Diagnosis.—Seeing that the animal had been directly exposed to the infection of strangles for a fortnight, I felt myself justified in suspecting a strangles lesion in the brain. I told the owner of what I thought, adding that if the symptoms arose only from stomach derangement the mare would recover; that, however, I did not think was the probable state of affairs.

Prognosis.—Decidedly unfavourable.

Treatment.—On the grounds that the symptoms might be arising from a disordered stomach, I applied a stimulating liniment to the poll, rugged the animal down, and administered a ball containing three drachms each of carbonate of ammonia and nux vomica.

I left a similar dose for administration again in the evening.

14th February.—9.30 A.M. Mare down, and this time unable to rise. Tongue hanging limp and pendulous from the mouth. Breathing stertorous and wholly *per os*. The use of all voluntary muscles lost. Respirations normal in number, as was also the pulse. The temperature too was the same as on the previous day. I did not attempt to treat the case further, and advised slaughter. This was not carried out, and the mare expired naturally in the early hours of the 15th.

Post-mortem.—This I was unable to make myself, but had the head and part of the neck sent up to me for examination. In no single gland present could I detect a sign or a trace of strangles infection, and I forthwith proceeded to remove the brain. I noticed nothing abnormal about the brain cavity—no signs of a blow, fracture, etc. The outer surface of the brain, too, appeared healthy as far as I could see.

On incising the brain, however, a flow of pus was the first thing to strike my attention. A large abscess was situated within the body of the right lateral ventricle, extending to and implicating the right olfactory bulb. Although unmeasured, I should estimate the quantity of pus to have been sufficient to have filled an ordinary wineglass. There were also several smaller areas of suppuration in the posterior substance of the right hemisphere. The left hemisphere was comparatively free, but small centres of pus formation of the size of peas could be detected studding its posterior half. The left olfactory bulb was free.

I regret that I was unable to be present at the examination of the carcase, but the knacker assures me that no other abscesses were to be noticed.

Microscopic Examination of the Pus.—Cover-glass preparations stained with methyl blue and mounted in benzol balsam revealed the

presence of strangles streptococci arranged in their characteristic chains. These occurred at regular but comparatively wide intervals throughout the pus.

Remarks.—The case is interesting mainly on account of the apparent freedom of the animal from disease, and the absence of all other lesions. It is interesting also to note that so large an abscess in that situation should have given the owner no more marked warning during its formation.

Questions.—Was the disease one of *general* blood infection, and its conveyance to the brain by that channel? Or did the infection of the brain take place by way of the lymph vessels through the cribriform plate of the ethmoid? Personally, I am inclined to think the latter.

A FEW NOTES ON FRACTURES.

By W. CARGILL PATRICK, M.R.C.V.S., Ballinasloe.

As fractures have been of rather frequent occurrence in my practice for some time past, I thought the following might be of some interest to the readers of your Journal.

Case I.

The subject was a twelve-years-old thoroughbred stallion, kept for stud purposes, and for which the owner refused £600 two years previously. Whilst being shown at a neighbouring town he was put in a stable to rest and feed, but it seems there was a mare in the next box, whose presence rather annoyed or excited him, with the result that he began jumping round the box, lashed out at a thick post forming part of the hay-rack, which was placed rather low, fracturing the suffraginis of the off hind leg. In answer to a summons by wire I arrived at the place, some thirty miles away, a few hours later, and on carefully manipulating the parts, could distinctly feel the bone fractured into half-a-dozen pieces at least. The animal being a valuable one, I decided to give him every chance, and I adopted the usual treatment in these cases—viz., plaster of Paris bandages, splints, etc., had him removed home in a float, administered a dose of physic, and ordered bran mashes and green food. I put him in slings the following day, but he only tolerated these for ten days or a fortnight at most, when he became so unmanagable that we were compelled to take him out of them, and give him a good, roomy, well-lit, aired, and littered box instead. The bandages were left on for about a month, when they were removed, disclosing a most satisfactory state of things. The parts had remained in the proper position, callus formation was all that could be desired, and only a small wound on the outer side of the fetlock had been caused by the bandages. This quickly healed under ordinary treatment, and everything pointed to a successful issue, which, I am glad to say, took place, as the animal was put to quiet walking exercise three months later, and has proved a most successful sire at stud since he was maimed four years ago. At present only slight lameness remains; in fact, had he been a gelding, he would have been workably sound.

Case II.

A bay six-years-old hunter, which had just been handed over to the groom in the hunting field, as he was too much of a handful for the lady who rode him, bolted, and fell in a ditch on his back, where he lay for some time, owing to the narrowness of the place and the awkward position he was in, and battered his head against a stone in the bank, causing fracture of the frontal bone. He was led home quietly and put in a comfortable loose-box, but appeared unable to eat or drink, and very sorry for himself generally. The owner, however, decided to wait until the following morning, hardly expecting him to live throughout the night. Next morning he was found in much the same condition, when the owner wired for my immediate attendance to see what could be done. On arriving about 10 P.M. that night, nearly thirty-six hours after the occurrence, I found the horse standing in a corner of his box in a semi-comatose condition, snoring loudly, as the head and nostrils were much swollen, mouth partially open, and the tongue protruding slightly. He had hardly moved out of the one position from the previous evening, and when he was made to do so he had a straggling, insecure gait. The seat of injury was more or less depressed, but there was no surface wound present. The horse was bled and a dose of physic administered. Cocaine was applied round the seat of fracture, and a large circular piece of skin was removed, when a depressed, starred, or radiating fracture of the frontal bone at the upper end of the sinus presented itself. The frontal was trephined at once, several splinters or plates of bone were removed from both frontal and ethmoid, and the parts were thoroughly cleansed, thus affording almost instant relief, as the tongue was retracted shortly afterwards, and the animal partook of a drink and some bran mash, appearing ever so much brighter than he was prior to the operation.

The after-treatment consisted in keeping the parts well syringed with a Read's pump, using a solution of creolin and chinosol, in combination with boracic acid powder by insufflation, removing sundry small plates of bone as they became loosened, keeping the wound open until all smell had completely disappeared, and then allowing it to fill up by granulation afterwards. The usual attention to diet, fresh air, etc. Complete recovery took place ten weeks after the accident.

Case III.

A black three-years-old mare, used for hack purposes, when going along the avenue with groom riding, stumbled, and fell on her nose, fracturing the premaxilla, knocking out two of the temporary incisors, yet hardly even blemishing her knees, merely knocking off the hair. On examining her mouth I found the incisors knocked out as stated above, longitudinal and transverse fracture of the premaxilla, and depression of fractured part, allowing the teeth of the upper jaw to cut into the gum behind the lower incisors. The transverse fracture was right across the jaw, complete; the longitudinal one was between the central and lateral incisors, and had a communicating surface wound. Several small splinters of bone were removed, the parts thoroughly cleansed, lateral and corner teeth wired to central permanents, then jaw bandaged, and an improvised mouth-plate affixed

in order to keep the parts in position. However, as the instrument in question left much to be desired, Huish's "Revelation" mouth gag, with the rubber or leather covered plates, suggested itself to me as being more suitable for the case, so I adopted its use, and found it to be a perfect instrument for the purpose. The parts were kept in proper position, equal pressure was attained by using the gag, the mare was at the same time prevented from using her teeth and displacing them while under treatment. The mouth was thoroughly and regularly washed with creolin after feeding, and the gag reapplied, until recovery took place.

The mare was sent home five weeks later, having made both a speedy and thorough recovery, leaving hardly any trace of the injury except a slight retraction of the gums, which in our patients does not constitute a serious defect or blemish.

A CASE OF QUARTER-EVIL IN A THREE YEAR OLD BULL.

By SYDNEY L. STEPHENS, M.R.C.V.S., Wadebridge.

A STATEMENT in a recent number of your Quarterly that quarter-evil is exceedingly rare in adult cattle induces me to report the following case.

Subject.—A valuable pedigree Devon bull in show condition, and *aged three years seven and a half months.*

History.—Had served a cow previous day, and had "got off" clumsily. Found lying down in morning. At mid-day showed lameness in left fore leg, with shoulder swollen. No appetite or rumination.

On the evening of this day (July 8th) I was called, and found the swelling very painful, but *not* emphysematous, and internal temperature 106° F.

I suspected quarter-evil, and warned the owner, but the age of the animal caused me to treat for severe sprain.

Next morning revealed the swelling to be emphysematous, and the bull died the same evening of quarter-evil.

SCABIES IN HARES.

By A. M. TROTTER, M.R.C.V.S., Sanitary Department, Glasgow.

SINCE publishing notes on "Scabies in Field Rabbits"[1] there have come under my observation two instances in which hares have been attacked by the parasite—sarcoptes minor. These animals were found on one of the estates already referred to.

The parts involved were in,

Case I.—Lips, face, forehead, lower half of the outer surface of the auricular concha, neck, forelegs, large irregular patch measuring 4½ by 2 inches on the left side of the chest, pubis, and hind legs.

Case II.—Lips, face, forehead, neck and pubis. A large part of the

[1] "Journal of Comparative Pathology and Therapeutics," Vol. XI., p. 4.

skin over the left side of the chest was devoid of hair, and so thin that the colour of the subcutaneous muscular tissue was plainly discernible. No evidence of the disease could be discovered either on the part on in the adjoining tissue.

The crusts did not, on macroscopical or microscopical examination, differ from those already described. Extreme emaciation was present in both instances. The internal organs were found normal.

Abstract.

ANTHRAX IN THE LOWER MISSISSIPPI VALLEY.[1]

DURING the spring and summer of 1896 there prevailed in the northern part of the state of Louisiana and in a few of the adjoining counties of Mississippi and Arkansas an exceptionally widespread and fatal epizootic of anthrax. In the extent of country infected, and in the number of animals attacked, this outbreak of anthrax is unprecedented in the scant history of the disease as it has appeared in the United States.

The infected territory was situated in one of the richest agricultural districts of the lower Mississippi Valley. It included Madison, Morehouse, Richland, Tensas, Concordia, East Carroll, and West Carroll parishes in Louisiana; Phillips and Chicot counties in Arkansas; and Bolivar, Issaquena, and Claiborne counties in Mississippi. Louisiana suffered by far the most severely, not only as to the extent of territory infected, but also as to the virulence of the plague. In that state several thousands of horses, mules, cattle, and hogs were attacked, and in some parishes a heavy percentage of them died. A few instances also occurred of its communication to man. In some localities a veritable panic prevailed. The loss of large numbers of farm animals, at a season when the crops were being made and harvested, seriously crippled agricultural operations, and the irreparable losses by small farmers of their entire animal power deprived many of them of the very necessities of life.

In Mississippi and Arkansas the infected territory comprised a much smaller area than in Louisiana, and the epizootic assumed in those States a much less sweeping and virulent form. In Mississippi the cases were few in number, and in Arkansas heavy losses were reported from Chicot County only.

Reliable evidence exists that anthrax prevailed in several localities of the lower Mississippi Valley at an early period, and has appeared locally at irregular intervals ever since. In 1836 a disease then known as "choking quinsy" prevailed in several counties of the swamp region of the State of Mississippi. The symptoms as described indicate that the disease was true anthrax. In 1865 many cases were again reported from the same region, and in the spring of 1867, a season that was marked by an unusually severe drought, an epidemic of anthrax set in, from which it is said that scarcely a mule escaped and 90 per cent. of those affected died; years elapsed before the planters recovered from their losses. Since 1867 the disease has

[1] From the Fourteenth Annual Report of the Bureau of Animal Industry, Department of Agriculture, U.S.A.

prevailed more or less in the same localities, and the years 1875, 1876, 1881, 1882, and 1889 were marked by light epidemics. In the northern part of the neighbouring State of Louisiana the disease seems likewise to have prevailed for a considerable period, and in the scant literature upon the subject occasional reference is made to local outbreaks of anthrax there, or of a strikingly similar disease, for a period covering almost half a century. In the same parishes that were affected in Louisiana in 1896 an epidemic, far less fatal and more restricted in area, occurred in 1884; but since then this section is said to have been practically free from the disease.

The exact origin of this epidemic is not known, but the probable origin can be surmised with considerable confidence.

Anthrax is said to have been occasionally observed in a sporadic form in the alluvial districts of southern Louisiana ever since the settlement of that country. Authentic records of its ravages, however, are somewhat scarce, and up to recent years a lack of scientific knowledge of the pathology of the disease has made intelligent investigation impossible. It is now, however, a well-known characteristic of this malady that when it is once introduced upon premises the soil, grass, plants, water, and other substances are liable to become impregnated with the germs of the disease. These germs are then very retentive of vitality and may remain pathogenic for years, so that animals which afterwards graze upon these lands or are fed upon the products of them are liable to contract the contagion. From the most remote times, in all countries where anthrax has prevailed, lands upon which it has existed have been observed to be disease-producing agents for long periods afterwards, though the cause was unknown.

Existing facts indicate that anthrax is enzootic in certain localities of Mississippi and Louisiana and that the present outbreak probably has some unknown correlation with outbreaks of the past. Indications point suggestively to the fact that certain localities of these States may be impregnated with the germs of the disease; and it is important to observe that the climate and soil of the low-lying lands of the Mississippi Valley are of that character which is known to be propitious to the long conservation of anthrax germs, and that meteorological conditions often prevail there which are extremely favourable to their dissemination from one locality to another.

The localities infected in 1896 lie in the rich and fertile alluvial bottoms of the Mississippi Valley, and border either upon the Mississippi River or its tributaries. The infected lands are invariably low, usually lying between the rivers and the adjacent uplands, and are interspersed with many swamps. These lands are almost yearly enriched in organic matter by springtime inundations. After the subsidence of the floods the favouring influence of a warm climate induces a rank and luxuriant growth of vegetation, but all extensive depressions in the soil are left covered with stagnant pools and the water stands deep in the ponds and marshes. Occasionally, as was the case in the summer of 1896, droughts of long duration follow; the ponds left by the inundations then subside; the herbage becomes withered; the pools, marshes, and smaller streams fall to a low level or dry up entirely; herbivorous animals are then compelled to seek water in the low-lying swamps and to graze either upon the rough forage of dried up and dusty pastures or upon the greener vegetation of low lands from which the water subsides only in seasons of drought.

In all anthrax-infected countries it has been observed for centuries that a mysterious correlation existed between such conditions as the above—that is, with respect to soil, temperature, humidity, inundations, and droughts—and outbreaks of this peculiarly fatal disease. This correlation was long erroneously regarded as being that of cause and effect, but in recent years the science of bacteriology has demonstrated that these natural conditions simply furnish

favourable media for the preservation of the germs and for the development of the disease and are in no way its direct cause.

Two forms of anthrax occur according as the germ of the disease gains access to the blood through the abrasion of an internal membrane or of an external surface of the body. If by an internal abrasion, there results acute, apoplectic, or internal anthrax, which usually runs its course rapidly, often without visible external symptoms, until the animal is in the throes of death; if by an external abrasion, cutaneous, carbuncular, or external anthrax results, which usually manifests itself first by swellings in the vicinity of the abraded and infected spot, runs its course less rapidly, is more amenable to treatment in its early stages, and is somewhat less fatal than the internal form of the disease. In all other anthrax-infected countries internal anthrax has been observed to be by far most common, and their literature is devoted chiefly to this form. In Louisiana this order seems to have been reversed; the recent outbreak was due largely to external inoculation, and carbuncular or external anthrax was at least equally as common as the more fatal form.

The reports received from the infected parishes of Louisiana, almost without exception, attributed the extensive spread of anthrax there in 1896 largely to external inoculation by flies; and many inquiries were made with the sole object of ascertaining some substance that would be efficacious, when applied to animals, in keeping flies off their bodies. The swarms of these insects indeed constituted a veritable plague. There were many varieties, chiefly the blood-sucking sort; but to the *Tabanus lineola*, a small, grey horse-fly, was attributed the principal agency in disseminating the germs of the disease. It is notable that in foreign countries, although it is recognised that the fly may carry the germ of anthrax upon its feet or body from a diseased to a healthy animal, or may infect a healthy beast with its proboscis after having drawn blood from the infected one, yet few opportunities have ever occurred for extensively observing this method of infection. But in the lower Mississippi Valley inoculation by flies has long been regarded as an especial source of danger. In an outbreak in the State of Mississippi in 1889 it is recorded that swarms of a particular species of horse-fly infested the infected districts, and attacked animals in such numbers as to leave upon the back, belly, and legs thick masses of clotted blood. This particular species was popularly believed to be the direct cause of the disease, instead of a mere medium of infection, and, therefore, became known as the "charbon fly." That flies also p'ayed an important part in the extensive dessemination of the disease in the recent epizootic in Louisiana there seems to be no room for doubt; and it will be readily recognised how exceptionally an important factor this method of dissemination may be in the spread of this disease. It has been observed in all anthrax infected countries that the disease is usually confined to limited localities, sometimes to a single field where the germs have found lodgment and remain localised. The removal of animals from such localities is often marked by a cessation of attacks of the infection; or animals may even remain in the locality for a long time and only a few of them, possibly only one or two, may take the germs into their systems and contract anthrax. But where flies become common, active agents in the dissemination of the germs in an infected area, particularly flies in such swarms as appear in the lower Mississippi Valley in warm, dry seasons, the disease is not likely to be limited to any defined locality, but to be spread over a territory limited only by the range of the flies.

Another factor, which was equal if not greater than the above in causing the epidemic of 1896 in Louisiana, was the careless disposal made of the carcases of dead animals. Especially was this true early in the epidemic before scientific knowledge of the cause of the disease and of the prophylactic measures necessary to combat it had been generally disseminated among the

people. In many instances it is known that animals were left lying in the woods or fields on the spot where death had overtaken them. In others they were dragged or hauled to the swamps and left exposed to the elements or thrown into the ponds, streams, and marshes. Even when burial was resorted to it was often made at shallow depth, and little attention was paid to the disinfection of the soil or of substances that might have become impregnated with germs or spores from the dead animal. Ignorance of the vital necessity of preventing spore formation resulted in a common lack of effort to prevent all unnecessary escape of blood in handling fresh carcases, or to destroy by disinfection the spores already formed in blood which had escaped from the bodies of living animals during the course of the disease. Few precautions were taken to keep living animals away from infected localities, or to keep carnivorous animals away from the carcases of the dead. Hogs and dogs were allowed access to fresh carcases, thus contracting the disease themselves and spreading the germs over wider areas. Buzzards were also believed to have added to the extensive spread of the contagion by feasting upon infected carcases and carrying the germs elsewhere upon their feet and bodies. Even the products of soil which had become infected by this careless disposal of carcases were doubtless in some instances a source of infection. A well-authenticated instance occurred where a number of mules which had previously shown no symptoms of ill-health were fed upon a newly-purchased lot of rice bran. A few days later anthrax attacked several of them. The bran was suspiciously regarded as being the vehicle in which the spores had been transported, and its use was temporarily discontinued. For the ensuing fortnight no more deaths occurred. It happened that by accident the bran was again used for feeding purposes, and three more animals died, showing symptoms of anthrax. The use of the bran was then permanently discontinued, the infected premises carefully disinfected, and the disease has not since appeared upon the plantation. A competent veterinarian, who had carefully studied this particular outbreak, gave the opinion that the rice bran was doubtless the source of the infection, and was probably a product of rice which had been raised on infected soil.

It was not found possible to obtain complete statistical returns of the number of animals attacked and the losses incurred from all the parishes of the infected territory. Approximate estimates, however, were received from five contiguous parishes of north-eastern Louisiana, which are valuable as showing the virulence of the plague, the species of animals which were most susceptible, the kinds to which it proved most largely fatal, and the pecuniary losses that it inflicted upon the communities.

The following is the statistical history of the epizootic in the above-mentioned territory, by parishes:—

[TABLE.

Table showing Number of Animals Affected with Anthrax, Number Dead from the Disease, and Value of Animals Dead from the Disease.

Animals.	*Number of Animals in Parish.*	*Number Affected with Anthrax.*	*Number Died of Anthrax.*	*Total Value of Animals Lost from Anthrax.*
Richland Parish—				
Horses	400	300	150	$11,250
Mules	1,720	860	420	33,600
Cattle	2,000	500	450	4,500
Sheep[1]	......	......	......	......
Hogs	3,000	1,500	1,200	3,000
Madison Parish—				
Horses	2,520	10	6	250
Mules	3,535	500	300	20,000
Cattle	4,892	500	350	3,500
Sheep	350	None.	None.	......
Hogs	2,335	1,000	1,000	2,000
Morehouse Parish—				
Horses	5,000	140	50	1,500
Mules	4,500	100	45	2,200
Cattle	13,500	100	30	300
Sheep	4,000	......	......	......
Hogs	40,000	......	......	......
Franklin Parish—				
Horses	1,650	175	85	2,550
Mules	600	200	96	3,840
Cattle	10,935	100	100	800
Sheep	......	......	......	.....
Hogs	......	......	......	......
East Carroll Parish—				
Horses	2,000	100	35	1,750
Mules	570	570	245	1,715
Cattle[2]	......	......	......	......
Sheep[2]	......	......	......	......
Hogs[2]	......	......	......	......

1 No statistics. 2 No noteworthy mortality.

A study of the above statistics will reveal some peculiar and unusual features in the Louisiana epidemic. Sheep, which have generally been given a first rank among the species of animals susceptible to this disease, seem, according to the received returns, to show almost an entire lack of receptivity. It would be interesting to know whether flies played even a more important part in the spread of this epidemic than has been attributed to them, and the natural covering of wool of this species of animal protected them from the attacks of these pests. On the other hand, swine have commonly been regarded as possessing a somewhat limited degree of refractoriness to this plague: yet in the returns above given from Richland and Madison parishes this animal shows a remarkable degree of receptivity, and of those attacked almost all succumbed to the disease. The easy access which these carnivorous animals had to infected carcases, through the commonly careless disposition made of the latter, naturally suggests itself as the probable cause of this unusual feature of this epidemic. It is also notable that horses and mules showed a greater susceptibility than cattle, though the latter have commonly been regarded elsewhere as yielding more readily to the infection.

In the early part of the Louisiana epidemic, when ignorance of the pathology

of the disease was all but universal among the people, the subject of curative treatment naturally attracted great attention, and the remedies suggested were as varied and innumerable as they were unscientific and ineffectual. As is usual in the early part of anthrax epidemics, before the virus of the contagion has undergone the attenuation which it has often been observed to undergo as the epidemic runs its course, all medicinal agents seemed powerless. Death usually occurred before the need of treatment was discovered. But later on in the epidemic, when the carbuncular form became more common and the swellings presented a definite point for treatment, multitudinous opportunities occurred for popularly recommended unscientific remedies. A few of them were extraordinarily severe and cruel. The swellings were pierced with pointed red-hot irons; concentrated lye was applied to them; they were burned with red-hot shovels; the swollen parts were saturated with turpentine and set fire to; and official record has been made of animals which had one continuous suppurating sore extending from the lower lip to the flank. As the epidemic progressed, however, and knowledge of the cause of anthrax became disseminated among the people through the medium of the press and veterinary science, these practices generally gave way to more enlightened methods of treatment. It is well known that where the germs of anthrax have actually entered the circulatory system, especially in considerable numbers, curative treatment is of little or no avail. But the unusual prevalence of the carbuncular form of the malady during this epidemic gave scientific curative treatment a prominence that it would not otherwise have possessed. When the swellings could be discovered in their very incipiency, and the germs had not yet gained the circulatory system, the injection of germicidal solutions into the enlargement seems in some cases to have been followed by good results by destroying the germs in their localised area. Many different solutions were prescribed. A preparation prescribed by the State authorities was a five per cent. aqueous solution of carbolic acid; to each ounce of this was sometimes added two grains of corrosive sublimate. The injection was made with an ordinary hypodermic syringe. Blistering of the swellings was also recommended, by means of liniments ordinarily composed of agents such as hartshorn, turpentine, camphor, iodine, chloroform, etc., mixed with oil, and the most dependent part of the enlargement was sometimes carefully scarified. The internal treatment prescribed, to be used in connection with the external, was the common purgatives usually recommended in cases of anthrax. Of these curative measures it seems only possible to state that individual experiences occasionally attributed remarkable efficacy to them, but the general history of their use in this epidemic is not calculated to inspire belief in general benefit from their use. Veterinarians reiterated again and again during the course of this epidemic that the only successful treatment of anthrax is not curative, but preventive; and persistent insistence upon the necessity of prophylactic measures gradually converted the public mind to a belief in them as the only source of relief.

The preventive measures recommended were on two lines:

(1) The treatment of healthy living animals by a process of vaccination which, it was claimed, would render them immune to the disease and the application to their bodies of a preparation to protect them from flies.

(2) The application of such sanitary measures throughout the infected districts as would tend to destroy or neutralise, so far as possible, every condition favourable to the further increase and wider distribution of the microscopical plant life which is known to be the cause of this disease.

The vaccine used in the Louisiana epidemic was the Pasteur anthrax vaccine, and it is said that 20,000 head of stock, mostly mules, were vaccinated. No statistical statements have been received from which can be formulated the general results of the use of this preventive.

THE

JOURNAL OF

COMPARATIVE PATHOLOGY

AND

THERAPEUTICS.

VOL. XII.—NO. 3. SEPTEMBER 30, 1899. PRICE 2s. 6d.

THE MEASURES TO BE TAKEN AGAINST TUBERCULOSIS OF THE DOMESTICATED ANIMALS.[1]

By Dr B. BANG, Copenhagen.

IT is necessary to combat tuberculosis of the domesticated animals, (1) on account of the danger to which human beings are exposed by the use of the milk and flesh of tuberculous animals, and through the tubercle bacilli which are discharged from the bodies of animals during life, and (2) on account of the notable economic loss which the disease occasions.

Inasmuch as the methods of averting the danger arising under the first of these heads is considered in another section of the Congress, I shall confine myself to a consideration of tuberculosis as a purely animal disease.

The disease is more prevalent among cattle than among any of the other domestic animals, and cattle are much more frequently the cause of direct or indirect infection of other species of animals than human beings are. Bovine tuberculosis will therefore here be considered in the first place.

Tuberculosis is spread solely by infection, that is to say, by the taking in of tubercle bacilli which have come from another individual, which may be either a human being or one of the lower animals.

The combating of tuberculosis must therefore aim at hindering the taking in of the bacilli. These bacilli may obtain access to the body either (*a*) during intra-uterine or (*b*) extra-uterine life.

[1] Translation of a paper contributed to the Proceedings of the Seventh International Veterinary Congress.

Fœtal infection plays a somewhat unimportant rôle, though it is true that congenital tuberculosis is by no means so seldom as was at one time supposed (on the ground of the statistics furnished by the large slaughter-houses). I have myself examined over one hundred cases of congenital tuberculosis, some of them being in the unborn fœtus and the others in the newly-born calf. But even in districts in which the disease is rather prevalent the proportion of cases of congenital tuberculosis scarcely exceeds 0·33 per cent. of the slaughtered calves.[1]

That this should be so is easily understood when one reflects that tubercle bacilli can pass from the mother to the fœtus only when they have developed in the maternal placenta, or when they have at a given moment circulated in the blood of the mother, that is to say, when the mother has suffered from generalised tuberculosis. In the great majority of tuberculous cows the disease occurs only in a local form, and a placental infection of the calf then cannot occur.

A germinative infection implies corresponding conditions. Here again there must be tuberculosis of the ovary or of the sexual organs of the male, or the presence of tubercle bacilli in the blood of one of the parents.

These theoretical considerations are in correspondence not only with the results of the *post-mortem* examination of young calves, but also with the fact demonstrated by me and other observers, that the proportion of young calves which react to tuberculin is much smaller than that of yearlings and adult animals.

In the following table I have arranged, according to their age, the animals which I have tested with tuberculin in Denmark since 1893:—

Calves up to six months old.	Total.	Percentage reacting
From October 1893 to October 1895 . .	7630	15·5
From May 1896 to May 1898 . . .	24,267	10·6
Young Cattle from six to eighteen months old.		
From October 1893 to October 1895 . .	11,313	29·4
From May 1896 to May 1898 . . .	36·920	19·0
Young Cattle from one and a half years to two and a half years old.		
From October 1893 to October 1895 . .	8921	40·5
From May 1896 to May 1898 . . .	22,425	25·6
Adult Animals.		
From October 1893 to October 1895 . .	25,439	49·3
From May 1896 to May 1898 . . .	67,263	32·8

Tuberculosis is, therefore, in most cases not a congenital disease, but one acquired during extra-uterine life.

[1] Veterinary-Inspector Knudzen, of Aarhuus, Jutland, in 1898 found 23 cases (0·39 per cent.) of congenital tuberculosis in 5941 calves killed in the local slaughter-house, and 29 cases (0·37 per cent.) in 7789 calves killed elsewhere and examined at the control station. In Kiel, however, Klepp found cases of congenital tuberculosis somewhat more frequently. In the first five months of the year 1896 he found 26 cases (0·64 per cent.) of congenital tuberculosis in 4068 new-born calves killed in the local slaughter-house, and in October he found 10 (1·18 per cent.) out of 847 calves killed during that month.

That tuberculosis is relatively seldom present in newly born animals is admitted by most authorities. In former times, however, a great importance was attributed to inherited predisposition. I am far from denying that the resistance offered to invasion by the tubercle bacillus (as in the case of other pathogenic organisms) varies with the individual, and I think it in no way improbable that these varying powers of resistance, just like other properties of the tissues, may be inherited.

In my opinion, however, it ought to be recognised (1) that in all probability the smaller or greater tendency to tuberculosis is evinced much more by a greater or smaller power of localising the disease than by a disposition which hinders the penetration of the germs, and (2) that actually we know very little about different degrees of inherited predisposition in cattle. Among cattle there scarcely exists such a degree of immunity against tuberculosis as will render the entrance of tubercle bacilli into the body impossible, or prevent the development of a tuberculous nodule in an infected animal. It is certain that every animal of the bovine species may become tuberculous. Regarding predisposition to the disease the reaction to tuberculin gives us no indication, for it may well happen that a slightly susceptible animal reacts because it has been accidentally exposed to an intensive infection, while another, perhaps markedly susceptible, does not react simply because it has never been exposed to any risk of infection.

In large herds containing animals of different strains I have never been able to recognise that the disease took a more malignant course in one strain than in another.

So long as a special predisposition to the disease is not recognisable, we ought, in my opinion, to attach no special importance to the alleged inherited tendency in the prophylactic measures which we take against the plague, and, in any case, it is absolutely unjustifiable to conclude that an ox or a cow is specially predisposed because it has reacted to the tuberculin test. So long as the parents are clinically sound, and the disease in them is betrayed only by a reaction to tuberculin, we need not fear on the part of the calf either a congenital tuberculosis or a special susceptibility to the disease. The calves are born healthy, and they remain healthy as long as they are protected from infection.

On the ground of the foregoing considerations I cannot attach anything like so great an importance to freedom from reaction on the part of bulls used for breeding purposes as is usually ascribed to it. It is obvious that such freedom from reaction is a valuable quality, and one which deserves to be taken into consideration, especially in the case of a high-priced imported bull. A bull that is to be used to serve cows that are free from tuberculosis ought obviously to be himself quite healthy, but one ought not to believe that a great step in the combating of tuberculosis has been taken by the exclusive use of bulls that do not react to tuberculin. As a rule, even such a "clean" bull will react half a year or a whole year after his introduction into an infected herd, and where does the advantage remain then? When one breeds from reacting cows all that is required of the bull is that he shall be clinically sound, for, as a matter of fact, the immense majority of such bulls will furnish

healthy semen. In judging bulls for the awarding of a premium it is decidedly important to allow something for freedom from reaction (to give several "points" for it). In view, however, of the present great prevalence of tuberculosis in most civilised countries, it is, I think, a mistaken policy to completely exclude from awards for a premium bulls that have reacted. It is possible that one might thereby exclude bulls which would have contributed to the improvement of the breed. Naturally I would desire that it should not be awarded to a bull that has reacted, as this would act in the direction of combating the disease. In this matter, however, breeding interests must be taken into consideration.

A much greater rôle is undoubtedly played by the susceptibility acquired in consequence of weakness, pampering, and previous attacks of disease, etc., than by inherited predisposition, and therefore, with a view to prevention, an appropriate diet and the bringing up of the calf in such a way as to give it a hardy constitution are of great importance.

During extra-uterine life infection may take place in several different ways. Among the rarer of these ways are infection through wounds, copulation, and the entrance of bacilli into the teat canal. Most frequently the bacilli are taken in through the digestive or respiratory organs. As is well known, there has been much dispute as to which of these is the commoner way, and it is still maintained by many people that, in the case of cattle, the bacilli are mainly taken in through the digestive organs. The result of *post-mortem* examination, however, is in contradiction with this view, since in many cases the tuberculous lesions are found only in the bronchial glands or in the lungs or in both of these. The interest in this question, however, is really more theoretical than practical.

From a practical point of view it is more useful to distinguish between :—

1. Infection through articles of diet which contain tubercle bacilli, and

2. Infection through cohabitation.

1. Under this head, in the case of cattle, one has to do almost exclusively with the admixture of tubercle bacilli with milk or milk products. In the infection of calves with tuberculosis, tuberculous milk plays a very important part. As a matter of fact, in the case of reacting calves one generally finds the lesions exclusively or mainly at the places where bacilli introduced with the food first penetrate, viz., in the retropharyngeal and mesenteric glands. This fact, however, is so well known and so easy to recognise that I need not discuss it at length, but I would like to call attention to the great danger attaching to the use of the milk furnished by a tuberculous udder. It ought further to be observed that without any clinically recognisable disease of the udder tubercle bacilli are sometimes excreted through the mammary glands of cows suffering from generalised tuberculosis. Perhaps more importance attaches to the fact to which A. Eber has called attention, namely, that the bacilli, which are certainly often present in the fæces of tuberculous cows, may very well be a source of infection of milk which is by itself quite normal. This explains how it is that even in herds in which

there is no case of udder tuberculosis, and perhaps even none of very advanced general tuberculosis, the calves, nevertheless, appear to become infected by the raw milk. That tuberculosis is so easily spread by public creameries is also ascribable to this fact.

The danger attaching to feeding with milk can be obviated by warming the milk to 85° C. In Denmark we have adopted this measure of prevention with the most excellent results. However, as these precautions are not yet employed daily and with the necessary care in the public creameries, one must in the meantime take special means of combating the most dangerous source of infection, namely, tuberculosis of the udder. In this there lies also a very great danger for human beings, especially because the milk secreted by the diseased quarter at the outset, and often for a considerable period after infection (a month or more), retains an almost normal appearance, and is thus undoubtedly often consumed. In the later stages, when the milk has become watery and flocculent, and is no longer milked into the pail, the milking of it on to the floor may contribute greatly to the infection of the cow-shed. I therefore consider it a most important step in advance that in Denmark, under the regulation of the 26th March, 1898, all cows in which tuberculosis of the udder is officially diagnosed are immediately slaughtered with compensation.

Pigs, carnivora, and domestic fowls may be infected with tuberculous milk, with tuberculous organs, or with the flesh of highly tuberculous animals. To combat this danger, diseased organs must be destroyed, and the flesh must be cooked.

2. In the case of the older calves and adult cattle the milk plays no part in infection. Here infection is brought about mainly by the cohabitation of tuberculous with sound animals, that is to say, by the accidental entrance of tubercle bacilli voided from some diseased animal. It is quite obvious that the danger of infection will be immeasurably greater in-doors than in the fields. It is certain, however, that even in the open air infection is not excluded, especially when the cattle are free to run about and lick one another, and when several animals are allowed to drink from the same vessel. When, as is the rule in Denmark, the cattle are tethered, and a separate drinking vessel is kept for each cow or for each pair of cows, the danger is much less than when the animals are kept together in-doors. The worse ventilated and the darker the stall, and the less the attention paid to cleanliness, the greater the danger. The danger is increased by keeping the cows in rows with their heads towards one another, by watering them at a common drinking trough, and also by the presence of old woodwork, etc., which is difficult to disinfect. But even the most approved construction of the cowshed, and the most careful attention to cleanliness will not completely obviate the danger. In enclosed buildings the bacilli voided from the animals accumulate, and in the course of months or years almost all the healthy animals introduced fall victims to infection. In such circumstances the bacilli may be inhaled in the dry or moist state, or they may be taken in with food or water. That this is so is proved by the observation that in large herds in which tuberculosis has been prevalent for years the great majority of the animals (70 to 80 or often up to 100 per cent.) react to the tuberculin test in spite of their healthy appearance,

whereas, on the other hand, one can often observe that in herds in which the disease was previously unknown only a single recently introduced animal, and possibly also its neighbours, will react. The peculiar fact that in badly affected herds all the adult cattle and most of the heifers and young bulls react, while the calves of a few months old in the same premises do not react, indicates that the danger of infection increases with the duration of the cohabitation. When the calves are separated from the other cattle and placed in special premises one often finds that relatively few of them become the subjects of tuberculosis (and then almost exclusively alimentary tuberculosis), even when the disease is very prevalent among the adult cattle.

It is thus firmly established that tuberculosis is mainly spread by the cohabitation of healthy and diseased animals in the cowshed. Herein lies the great difficulty of dealing with tuberculosis under our climatic conditions, which necessitate the cattle being kept in-doors for a large part of the year.

The influence of cohabitation on infection is very distinctly shown by the favourable and also by the unfavourable results of attempts to combat the disease by effecting a separation between the healthy animals and those that react. Very often farmers are not inclined to go to great expense in effecting a complete separation. They think that it would be quite sufficient to put the sound and the reacting animals to opposite sides of the building, or to prevent promiscuous contact by an incomplete partition. In such cases the result is almost always unfavourable when the test is repeated at the end of the year, whereas, on the other hand, when the separation is carefully carried out the result is as a rule satisfactory, and, indeed, almost always proportional to the care that has been taken to prevent infection by intermediary bearers. The separation is best effected by keeping the sound and the reacting animals on different farms; the next best plan is to keep them in different buildings on the same farm, and a less good arrangement is to keep them in opposite ends of a building divided into two by a close wall. This last plan is least satisfactory when the dividing wall has a door in it. I have, however, now and again seen good results obtained under such conditions, especially when the door was opened as seldom as possible.

It thus appears that the main thing to aim at in combating tuberculosis of cattle is the prevention of infection by separating the sound from the diseased animals.

The first thing to do is to find out which animals are diseased. Whereas in most cases this was almost impossible before the discovery of tuberculin, the recognition of tuberculosis in the living animal has to-day been made much easier, but, nevertheless, not in all cases.

When a herd is tested with tuberculin for the first time the indications afforded are in most cases pretty clear. The animals which give a typical reaction are all, or almost all, tuberculous, although the reaction gives no indication regarding the extent of the disease. The animals in which no reaction occurs are at least to the extent of 90 per cent. free from tuberculosis.

It is a known fact that some animals at a very advanced stage of tuberculosis will not react, but as a rule these cases can be detected

by a careful clinical examination (which ought to include an exploration per rectum). If the clinical examination of such animals is omitted they may be left in contact with the sound animals, with the result of defeating the measures put into force. Of much more frequent occurrence are cases in which a few old caseous and calcified tubercles, generally in some one of the lymphatic glands, are found at the *post-mortem* examination of an animal that has not reacted. However, the introduction of such an animal among healthy animals will very seldom have any bad effect, because as a rule in these cases the lesions are at a retrogressive stage and do not subsequently become active.

Hence, it appears that in the rational attempt to combat tuberculosis by separating the diseased herd into two divisions, tuberculin, in spite of its defects, is, when carefully used, as a rule capable of doing all that is required of it in practice.

Tuberculin, however, has still another defect besides those mentioned. First among these is the fact that through repeated inoculation animals acquire a tolerance for tuberculin. As is well known, it very often happens that a cow which has reacted will not react again when re-tested after a short interval. It is true that this is comparatively seldom observed after the first reaction, but by repeating the injection several times one can, as a rule, bring about a temporary insusceptibility. Unfortunately, this makes it possible to practice dishonesty in dealing, and places great difficulty in the way of acquiring a sound herd by purchase.

It would, therefore, be desirable to make it obligatory to mark all reacting cattle, but this would be difficult to carry out so long as the law does not compel the examination of all cattle. In the meantime, a warranty ought, as a rule, to be obtained from the seller, and the introduction of cattle of unknown origin into a sound herd ought to be absolutely prohibited.

The fact to which I have called attention in previous publications,[1] namely, that even when the tuberculin test is first repeated after the lapse of a year a considerable number of animals that reacted on the first occasion fail to do so on the second, is much more difficult to understand than the immunity acquired by repeated tests at short intervals. In many of these cases I found at the *post-mortem* examination comparatively small lesions, which, although not healed, were stationary and obsolete. In other cases, however, extensive disease was found in such animals. It is necessary to know this, so as to warn the owners in the strongest possible way against regarding such animals as cured. Animals which on the ground of a typical reaction have been placed in the reacting division ought never again to be admitted amongst sound animals.

The diagnostic value of tuberculin is further diminished by the fact that cattle which have been removed from their ordinary surroundings, have recently made a journey, or been exposed in a market, etc., generally react very slightly or not at all.[2]

It appears as if mental excitement diminished the susceptibility of the heat centre for the substances developed in the

1 "Deutsche Zeitschrift für Tiermedizin," Vol. XXII., pp. 13-14.

2 M'Fadyean has specially insisted upon this fact. Report of the Royal Commission, 1898, Part I., p. 3.

tuberculous tissue under the action of the tuberculin. It is important to know this, as it explains many of the cases of failure with the tuberculin test. It often happens that cattle which are sold by a dealer with a veterinary certificate of non-reaction react a short time afterwards with the new owner, and this is well calculated to shake confidence in the tuberculin test. Such cases do not prove either carelessness on the part of the veterinary surgeon or dishonesty on the part of the dealer (through his having induced immunity). The veterinary certificate to the effect that there was no reaction is explainable by the fact that the animal when tested was under the action of one of the before-mentioned influences. It is therefore necessary in testing cattle that have changed hands to give them a few day's rest, and to use a larger dose than usual, as otherwise the temperature may not rise to the usual height.

The before-mentioned defects certainly diminish the value of tuberculin as a diagnostic agent, but they do not make it worthless. In spite of them, tuberculin remains a most valuable and indispensable assistance in combating bovine tuberculosis, but the use of it demands care.

From the foregoing considerations regarding the way in which infection takes place one sees immediately what measures require to be taken when a cattle-owner desires to eliminate the disease from his herd. The progeny of cows and bulls suffering from advanced tuberculosis must not be reared, but all others may be kept, provided they are immediately removed from the infected building and their infection through the diet is prevented by giving them only milk which has been boiled or heated to 85° C.[1]

When healthy animals are kept permanently separated from the diseased, and care is taken to prevent infection through the agency of the attendant or the utensils, they undoubtedly remain healthy. In favourable circumstances it would even be possible for a cattle owner to free his herd from tuberculosis in this way without having resort to the tuberculin test. It is obvious, however, that it requires a long period to succeed in this way, and that it also demands extensive accommodation and determination on the part of the owner.

As the diagnostic importance of tuberculin became known, one soon saw how it might be used in order to shorten the process. I have recommended that the owner should, with this object, have his whole stock tested, and immediately thereafter effect an entire separation between the reacting and the non-reacting animals; further, that he should have the animals found to be healthy retested every year, or, better still, every half year, in order to be able to remove as quickly as possible any animals which in the interval may have contracted the disease in spite of their isolation. I believed that in this way one would be able to attain the object in view, even when the facilities for separation were not altogether perfect. As is well known, I have carried out this plan since 1892 on one farm (Thurebylille), and since 1893 it has been put in force on many farms in Denmark. In many other countries also resort has been had to this or some quite similar plan, and, so far as I am aware, corresponding results have generally been attained. Regarding the improvements effected in Denmark, I

[1] Calves may be fed in this way after the second day, but during the first day they must be given the colostral milk. The danger of infection thus arising is very slight.

have already made a short report to the International Veterinary Congress which met in Berne in 1895.[1]

I have also described these results at length to the Congress on Tuberculosis held in Paris in 1898. In the report to that Congress, to which I may here refer, there is attached an appendix setting forth the results attained on a series of larger and smaller farms.

Taken as a whole, the plan is not only theoretically correct (rational) but also practicable. It is true, as I have already mentioned, that the execution of it is attended with many difficulties. In particular, the separation of the stock into two divisions at the same farm demands a great deal of trouble, and it cannot be denied that the before-mentioned defects of tuberculin not seldom also create difficulties.

If it is now asked whether or not, as a result of my somewhat extensive experience, I have found any points which require special attention in order to obtain favourable results, I would, in addition to the remarks already made on this head (careful carrying out of the separation, thorough disinfection of the building set apart for the sound section, correct interpretation of the results of the tuberculin test), call special attention to the necessity of watching closely the reacting division. That is to say, should any animal in this division of the herd develop a form of the disease attended with special danger of infection—one associated with a very abundant discharge of bacilli, such as tuberculosis of the udder, uterus, or intestine, or an ulcerating tuberculosis of the lung—it must be slaughtered as quickly as possible. Such an animal may daily void an enormous number of tubercle bacilli from its body, and thus give occasion for spread of the disease to the healthy section.

When one has to do with a large herd in which tuberculosis has been prevalent for many years, one may as a rule omit the testing of the adult cattle. In such a case the majority of these will react even when they appear to be quite sound.

Experience has taught me that even among the few that do not react a somewhat large proportion may not be free from tuberculosis. Cattle which have lived for several years constantly exposed to risk of infection from their neighbours as a rule contain bacilli, and harbour in their bodies some old, small tubercles, mostly in the bronchial or mediastinal glands. To this category, indeed, belong most of the individuals which, as mentioned above, do not react although they are tuberculous. Although such animals do not generally become dangerous, a further development of the disease in them is not excluded, and therefore it is best not to admit them to the healthy division. In large tuberculous herds it is consequently better to include in the sound section only the calves and the non-reacting young cattle. In this way the owner is spared the pain of seeing that the majority of his cattle are not free from tuberculosis. For herds that are only slightly affected I always recommend that the whole of the animals should be tested.

The method here described, imperfect as it is, furnishes a means by which the owner, with some trouble it is true, but without great economic loss, may free his stock from tuberculosis.

[1] A rather fuller report on the same subject appeared in the "Deutsche Zeitschrift für Tiermedizin," Vol. XXII.

What has been said above implies only a voluntary attempt to combat tuberculosis, not a legislative control as in the case of other infectious diseases of animals. In my opinion, the State can and must assist voluntary efforts by supplying the tuberculin gratis or at a low price, and by paying the veterinary surgeons for carrying out the examinations, as is done in Denmark, Norway, Sweden, and several other countries.[1]

One may now reasonably ask whether the State ought not to directly undertake the measures necessary to combat bovine tuberculosis, and whether the disease (in most countries the most prevalent of all) should not be dealt with like other infectious maladies.

In the first place, one must know whether it is possible to stop the sources of infection.

It has often been asserted that cattle are frequently affected from human beings; indeed, at the Berne Congress Professor Guillebeau asserted that the ox is mainly infected by sputum from phthisical human beings (General Report, p. 681). If this were correct it would be useless to think of combating bovine tuberculosis in the meantime. I am convinced, however, that it is entirely erroneous. Infection of cattle by bacilli voided from the human body is undoubtedly possible, and one should therefore not allow consumptive persons to act as attendants upon cattle. At the same time, there are very few observations on record pointing to this method of infection.

On the other hand, when tuberculosis first breaks out in a previously sound stock it can almost always be ascertained that the disease was introduced by an affected animal, or through the feeding of calves with tuberculous milk sent out from some public creamery. Against the view that bovine tuberculosis has frequently a human origin, there stands also the fact that a great number of stocks entirely free from tuberculosis are to be found in countries in which tuberculosis is very prevalent among human beings. In countries in which tuberculosis of cattle was originally almost unknown, but in which it has steadily become more prevalent during the course of the present century, it can almost always be ascertained (as I have done in the case of Denmark) that the disease was introduced with cattle from countries in which tuberculosis was of common occurrence.

Just as in the case of human tuberculosis the chief source of infection is man himself, so also bovine tuberculosis comes mainly from the ox.

The recent experimental investigations of Theobald Smith of Boston (*Journal of Experimental Medicine*, Vol. III., 1898) have shown that the ox is much more easily and more severely infected with cultures obtained from bovine tuberculosis than with those obtained from lesions of the human subject. The possibility of

[1] It is obvious that this assistance should be made conditional on the owner undertaking to keep the healthy animals and the reacting or untested animals in separate buildings, for otherwise it is useless to carry out the test. It is also very much to be desired that the reacting animals should be branded. This is the rule in Norway, where it is also ordained that such animals shall be sold for slaughter only. This could be hardly carried out without special compensation in countries where the disease is very prevalent, for otherwise the owner who made a rational attempt to deal with the disease would be placed in a less favourable position than those who do nothing at all, but simply sell their cattle. Moreover, I think that the regulation which forbids the sale of reacting cattle, save for slaughter, is too stringent. It would, in my opinion, suffice to require the animals to be marked, for reacting animals may be profitably kept for years, and their introduction into an already affected stock entails scarcely any aggravation of the state of affairs. It is sufficient that the purchaser should know what he is buying.

infection from tuberculous human beings, therefore, need not frighten us from attempting to combat bovine tuberculosis.

The idea of combating the disease is not at all utopian. Bovine tuberculosis is not, as was formerly supposed, an ubiquitous disease following on the forced development of the cow as a milking animal, for many stocks which are quite free from tuberculosis contain most excellent milkers. The disease is introduced with infected animals or with infected milk. It is possible to prevent it, and it is also possible to get rid of it. The circumstances, however, which make the task of stamping out bovine tuberculosis so very difficult are:—(1) The great prevalence of the disease; (2) the fact that in most cases the disease occurs in a form which entails only slight economic loss, and which apparently would not justify the slaughter of all tuberculous cattle; (3) the before-mentioned relative unreliability of tuberculin as a diagnostic agent.

That in most civilised countries tuberculosis is widely prevalent among cattle is a fact which I need not discuss at any great length.[1] It is true that in some countries, such as Norway and Finland and some parts of France, the native uncrossed breeds are still comparatively little affected. In most countries, however, careful examination in the slaughter-houses and the application of the tuberculin test show that a very large proportion of the adult cattle are affected with tuberculosis.[2]

With regard to the second point, it is well known that at the *post-mortem* examination of reacting cattle as a rule only unimportant lesions, entailing no economic loss, are to be found. I have had the opportunity to trace the history of such reacting animals for many years, and in several cases I ascertained that in cattle which had reacted five or six years previously the disease had remained quite stationary and very limited in extent.

The observations made in slaughter-houses have also shown that in the immense majority of tuberculous cattle the lesions are so circumscribed that under the now generally recognised rules of meat inspection their flesh may safely be passed for human food.[3]

One need not refrain from carrying out the slaughter of reacting cattle because the loss resulting therefrom would be comparatively slight. But it is precisely the knowledge of the relative harmlessness of the most common forms of bovine tuberculosis which will prevent Governments from compelling the slaughter of all tuberculous animals. In this connection much may be learned from the extensive experiments with regard to the stamping out of tuberculosis which in recent years were made in Massachusetts and in Belgium.

The task which the authorities set before them in Massachusetts (1894) was to slaughter as quickly as possible all tuberculous cattle. The inspectors in the various districts had to examine the whole of

[1] In my report to the Congress on Tuberculosis which met in Paris I have given figures relating to a number of different countries. I may here refer readers to that report.

[2] The fact that in Denmark tuberculin was used earlier and on a larger scale than in other countries, and the publication of the information thereby obtained, have given currency to the erroneous belief that tuberculosis is therefore specially prevalent here. In face of the statistics now available from other countries it does not appear as if the proportion of 28·8 per cent. found by me were uncommonly great.

[3] Siedamgrotzky has called attention to the fact that in Germany at the outside only from 2 to 3 per cent. of the tuberculous animals are totally condemned, while from 5 to 6 per cent. are sent to the Freibank, and about 92 per cent. are passed as quite wholesome (*Archiv f. Thierheilkunde*, Vol. XXIV. p. 67).

the cattle at least twice a year. Every animal suspected of tuberculosis was tested with tuberculin, and in the case of reaction the animal was killed and compensation was awarded (half of the value). When it had become evident that this procedure would never suffice to stamp out the disease, the systematic testing with tuberculin of all the cattle in three small districts was tried, but that also had soon to be abandoned, as the cost was too great. In addition, all cattle imported from other States had to be tested with tuberculin, and those that reacted were sent back.

In the following year the regulations with regard to the testing of suspected cattle were altered so as to give greater influence in the matter to the State Veterinary Commission. An attempt was also made to incite the owners to deal with tuberculosis in a rational manner by isolation and disinfection, but, as it appears, without any great result.

Although, as shown by the report made by Dr Parker to the Veterinary Congress in Nashville in 1897, there can be no doubt that the cases of malignant (generalised) tuberculosis were reduced in number (from 32·6 to 3·6 per cent. of the slaughtered animals), the efforts must be considered to have failed, for the Veterinary Commission in the report which it issued in January 1898 admitted that in spite of the very great expenditure (latterly 250,000 dollars yearly), no appreciable reduction in the prevalence of bovine tuberculosis was recognisable.

In consequence of this, in the year 1898 the Government refused to vote any more money to the Veterinary Commission. This was truly a sad result, and in a large measure it was brought about by the high rate of compensation paid for the slaughtered animals, the flesh of which was condemned even when the disease was of very slight extent. In any case, the Massachusetts experiments show the great difficulties which stand in the way of combating bovine tuberculosis by means of legislative enactments. The same is shown also by the experience of Belgium.[1] The law which was introduced there in January 1896 was essentially as follows:—

1. Compulsory notification on the part of the veterinary surgeon and the owner in every case of tuberculosis discovered either in the living or slaughtered animal (or after natural death).

2. Veterinary examination of the stock from which the tuberculous animal came.

3. Slaughter of the clinically tuberculous animals and also of those suspected in consequence of a reaction to tuberculin, the owner at the same time to receive compensation.

4. Disinfection of the building.

5. Prohibition of the sale of suspected animals (that is to say those which had been in cohabitation with a tuberculous animal) save for slaughter. The only animals exempted from this were those that did not react.[2]

6. The cattle of every owner to be tested with tuberculin at the cost of the State, on his undertaking to effect a separation between the sound and the reacting animals. In herds in which no case of

[1] It was a lecture given by Nocard at the International Agricultural Congress in Brussels which gave the impulse to the stamping out of tuberculosis in Belgium.

[2] The owner was thus indirectly compelled to resort to the tuberculin test.

tuberculosis had previously been detected the owner himself had to bear the cost of the tuberculin test. The sound division, into which only animals that did not react to tuberculin could be introduced, had to be re-tested annually.

7. The milk of reacting animals could be sold only in the cooked condition. The animals themselves had to be slaughtered within a year. Private persons were forbidden to test animals with tuberculin. Save in the case of animals intended for slaughter, all imported cattle had to undergo the tuberculin test while quarantined at the frontier.

These regulations were in the main rational, but No. 7, which compelled the slaughter of reacting cattle even when they appeared to be clinically quite healthy, went too far.

The experience gained during the first year and a half of these operations showed that it was necessary to make some important changes in them. In introducing the new regulation on the 10th August 1897, the Minister said:

"The large number of tests made with tuberculin in the year 1896 have shown that tuberculosis is so prevalent [1] in Belgium that the slaughter of all affected animals within a relatively short period would, without any real necessity, create the most serious inconvenience to many agriculturists. On the other hand, the slaughter of animals that had been submitted to the tuberculin test has shown that in the immense majority of cases they are only slightly attacked with tuberculosis, and are not capable of propagating the disease. In these circumstances it hardly appears necessary to compel the sacrifice of such animals within a definite period. In almost all cases it would suffice to isolate them, without preventing the owner from making full use of them as long as they do not exhibit manifest symptoms of the disease. In view of these considerations I believe I am justified in making various modifications which will have the effect of sensibly diminishing the rigour of the law of 30th October 1895."

The alterations thus effected comprise some that are very useful, especially that which permits the owner to keep his reacting animals so long as they do not show any clinical symptoms. However, he receives no compensation when they are slaughtered unless this has been carried out within three years. It is also right not to insist that the milk of such animals should be boiled. On the other hand, the new regulation ordains that the calves of reacting cows must be immediately separated, and after the second day fed with sterilised milk. Less useful appear the limiting of the duty of reporting to veterinary surgeons, and the official veterinary inspection of herds which are kept for breeding purposes.

The regulations also appear to have been weakened in so far as animals suspected of infection, that is to say, those that have been in cohabitation with tuberculous cattle, may be sold for other purposes than slaughter so long as they are not clinically diseased. This practically amounts to an abandonment of the attempt to stamp out the disease.

On the other hand, the measures for dealing with the apparently diseased animals are pursued with the same energy as before. The "clinically diseased" animals must be slaughtered within eight days, and the "clinically suspected" must be separated, unless the owner prefers to have them tested and killed at his own expense provided

[1] In all 2905 herds, including 19,004 cattle, were tested, and of these 48·8 per cent. reacted.

they react. The compensation given for breeding cows and for pregnant heifers is increased, inasmuch as it is to be based not on their value after slaughter but their value according to the purpose for which they were used. This, however, applies only to the first occasion on which the disease is detected in a herd. In the case of animals slaughtered in consequence of their having reacted to tuberculin the compensation is based on their value after slaughter.

As in the former regulation, it is still forbidden to sell for other purposes than slaughter diseased or suspected (this including also reacting) animals.

The regulations with regard to the isolation of the sound division of a herd that has been submitted to the tuberculin test are needlessly stringent, seeing that it is now permitted to introduce new animals into the sound division without their having been submitted to the tuberculin test provided they exhibit no clinical symptoms.

The attempt made in Belgium to stamp out tuberculosis is very interesting. The method was more rational than the one employed in Massachusetts, where, besides, there was no well-organised veterinary service, a large number of the inspectors having had no veterinary training. Furthermore, in Belgium general meat inspection has been in force for years. Belgium is also a rich country, where parliament is prepared to spend large sums in the agricultural interests. In the year 1897 alone, more than one million francs was paid in compensation for slaughtered tuberculous cattle. Nevertheless, the object which was originally entertained of stamping out bovine tuberculosis has already been abandoned. Herr Stubbe, the Chief Inspector in Belgium, at the Paris Congress last year expressed himself as follows:—

"It would be better, we think, to proceed more slowly but surely. There is no occasion to 'rush' matters when one has in view an object requiring some time for its attainment. The extermination of tuberculosis requires time and money."

It is to be regretted that under the new law the very useful regulation which indirectly compelled the owner to resort to the tuberculin test when cases of the disease occurred in his herd is no longer enforced, and it will therefore be less frequently carried out than formerly. "The intelligent owners, however, have recourse to it." Unfortunately, the intelligent owners are always in the minority.

Up to the present time in Belgium no legal enactments are in force to prevent the spread of tuberculosis from public creameries, but this is a defect which probably can be easily remedied.

I do not doubt that Belgium will gradually be able to materially diminish the prevalence of bovine tuberculosis, provided sufficient money can be found to admit of the slaughter of all clinically diseased, clinically suspected, and reacting animals. It is just as certain that it will not succeed in stamping out bovine tuberculosis so long as the reacting animals are not separated from the healthy ones. Unfortunately, even this regulation will not always suffice, precisely because one must reckon with the relative uncertainty of the tuberculin test. The most rational procedure would be to treat bovine tuberculosis in the same way as contagious pleuro-pneumonia of cattle, that is to say, to compel the slaughter of all animals

suspected of infection, but it is obvious that in the meantime such a drastic method is not to be thought of; it might be advisable on the first introduction of the disease into a country previously free from it, but even in such a case it would be a mistake to altogether overlook tuberculosis of the human subject as a source of infection.

At the present time the stamping out of bovine tuberculosis is not to be thought of. For an indefinite time to come efforts must be limited to an attempt to gradually repress the disease, to diminish its severity, and to reduce the danger for the human subject which it carries with it.

What are the appropriate means for attaining this object?

1. The first thing to be done is to disseminate correct views regarding the nature of tuberculosis, the methods of infection, and the importance of the tuberculin test.

Regarding all these points not only the farmers but all the inhabitants of the country ought to be instructed.[1]

One must persevere in this direction for a long time to come, until correct information regarding the matter has been clearly brought home to the people. It must not be forgotten that professional opinions regarding tuberculosis of cattle have been greatly changed, especially during the last ten years, since the introduction of tuberculin, and one can therefore easily understand that farmers have difficulty in assimilating modern views. But without a correct understanding of the matter one cannot expect rapid success in the attempts to combat the disease.

2. The second tremendously important task is one affecting the owners of cattle. It is for them to gradually cleanse their herds from tuberculosis by preventing infection of the calves and all other as yet healthy cattle.

Already much may be done in this way where breeding is carried on. Without the voluntary co-operation of the owner it is impossible to do anything against the disease. The State, however, can assist the owner by supplying the tuberculin and the services of the veterinary surgeon free of cost.[2]

3. The third step is to immediately dispose of the badly diseased animals.

When diseased animals discharge large numbers of bacilli, as is the case in ulcerating tuberculosis of the lung and tuberculosis of the intestine, uterus, or udder, but not in *perlsucht* of the serous membranes, or in tuberculosis of the lymphatic glands, it is in the interest of the owner himself to quickly dispose of the animals, which constitute permanent centres of infection. Without compulsion, however, little can generally be attained in this direction, especially since the owner, in many cases, does not apprehend the real nature of the disease.

It is, therefore, necessary to ordain by law that the owner must notify all suspected cases—chronic diseases of the chest associated with emaciation, cases with vaginal discharge apparently not due to retained placenta, insidious udder disease accompanied by the formation of a hard swelling but without immediate alteration in the

[1] Such instruction ought also to embrace the hygienic construction of cowsheds, rules for disinfection, and the necessity for destroying diseased organs.

[2] In order not to impose too great a strain on the Exchequer, well-to-do owners might themselves defray the veterinary expenses.

character of the milk, and chronic diarrhœa, especially in combination with chest symptoms. As soon as the nature of the disease has been determined by the veterinary surgeon, the animal must be separated from the other cattle, and slaughtered within a short period. In cases of tuberculosis of the udder and uterus the diagnosis must always be based on the detection of tubercle bacilli in the secretion (which is best done in a central station). In cases of suspected tuberculosis of the lung the diagnosis might be fortified by the tuberculin test. In this connection it ought not to be forgotten that an animal with some non-tuberculous disease of the chest (determined by worm parasites for example) might react owing to the simultaneous presence of an unimportant tuberculous lesion in a lymphatic gland.

Where general meat inspection is carried out, the veterinary surgeon or meat inspector might be required to report, as Siedamgrotzky has recommended.[1] It would then be possible to ascertain the origin of animals found to be tuberculous on slaughter, and to subject the herds from which they came to veterinary inspection. All this of course would leave unaffected the obligation of the owner to report.

Subsequent veterinary re-examinations of infected herds (about once a quarter, as Siedamgrotzky has recommended) are undoubtedly valuable.

Although the necessity for prompt slaughter of badly tuberculous animals (especially those suffering from some form of the disease peculiarly liable to spread the infection)[2] is hardly denied by anyone, opinions with regard to the question of compensation are still divided. Most members of the profession are in favour of compensation. It is not unreasonable that it should be granted, and, indeed, to the full value in cases of errors in diagnosis. It may, however, be questioned whether in every case compensation ought to be given for badly tuberculous animals. It might be given in view of the present depressed state of agriculture, although in the majority of cases it is useful to the owner, rather than injurious, to quickly get rid of such animals. In no case ought the compensation to be high, for if the farmers were not constantly reminded that tuberculosis occasions some sensible loss they would cease to do anything. It is also important to notice that even low compensation would require very large sums, and it would therefore be difficult in most countries to find the necessary means. Perhaps the best way of solving the question would be to introduce a system of compulsory insurance.

Slaughter of the animals worst affected is a regulation necessary to check the spread of the disease, but it is not sufficient to stamp it out. Under all circumstances the owner ought to be encouraged to combat the disease voluntarily by the use of tuberculin, isolation, etc. Where it is found to be impossible to give compensation for all the loss sustained, it ought, at least, to be granted for the slaughter of clinically tuberculous animals belonging to farmers who have earnestly carried out the voluntary method of combating the disease. That

[1] "Archiv. f. Tierheilkunde," Vol. XXIV., p. 76.

[2] It would be quite rational to treat animals which discharge bacilli abundantly in a different way from those in which the tuberculous lesions do not stand in direct communication with the outer world. I admit, however, that it is scarcely possible to carry out such a distinction in practice, when legal definitions have to be taken into consideration.

would insure the separation of the sound from the diseased animals, and it would perhaps also pave the way for introducing a system of marking the reacting animals.

4. Tuberculosis of the udder, on account of the great danger of infection which it carries with it, demands special attention.

It is not only a serious source of dissemination of tuberculosis within the affected herd, but, through the agency of public creameries, it is also dangerous for other herds. Lastly, this is the form of the disease which specially endangers public health. In any case, therefore, this form of the disease must be combated by law, even if regulations against the other specially dangerous forms are in the meantime not enforced. It would, in fact, be inexcusable if everything possible were not done to prevent such an important article of diet as milk from being converted into a dangerous poison. And that the danger is great cannot be doubted, when one reflects that the milk furnished by a tuberculous udder retains its normal appearance for weeks, and is undoubtedly employed as long as that for human food. It will be a long time before we can insist that only boiled or adequately pasteurised milk shall be used.

It is true that tuberculosis of the udder most frequently occurs in cows which would on other accounts be classed as "clinically tuberculous," but that is not always the case, as it is also met with in apparently healthy well-nourished animals which are free from tuberculous lesions in other parts of the body. It is therefore advisable to insist upon the immediate slaughter of every animal affected with udder tuberculosis.[1]

5. On account of the great risk of the disease being spread by public creameries, these ought to be forbidden by law to return the separated milk before it has been heated to 85° C.

The slaughter of animals affected with tuberculosis of the udder does not make this regulation superfluous, because even the milk from cows not affected with mammary tuberculosis may contain bacilli, probably often in consequence of particles of fæces mixed with it. When the creameries also offer to return the butter-milk they ought to be compelled to heat the cream before butter is made (as has been the case in Denmark since 1st June 1899). This has no injurious effect on the butter, but it deprives that of all risk of infection. Strictly speaking, the whey ought also to be heated to 85° C., but this may be omitted, since, in general, the whey is used only for feeding pigs. On account of the special danger attaching to the sediment obtained when the milk is "separated," steps should be taken to render this innocuous. Under the Danish law it has to be burned.

I hope that the Congress will recommend the above-mentioned points to the different Governments as being deserving of their consideration and support. It is true that the execution of them would not secure the complete eradication of bovine tuberculosis, but they would impose a gradual check on this formidable plague. Some decades hence it may be possible to take more energetic measures.

[1] The Danish regulation allows the owner a compensation of 25 per cent. of the value of the carcase when the latter is passed for food, and in other cases 75 per cent. In all cases the diagnosis is based on a microscopic examination of the milk, samples of which are sent to my laboratory by the veterinary surgeons.

THE MEASURES TO BE TAKEN TO COMBAT THE EPIZOOTIC DISEASES OF THE PIG.[1]

By E. LECLAINCHE, Professor at the Veterinary College, Toulouse.

THE diseases grouped under the head of the "red diseases" of the pig comprise—(1) a well-defined affection, viz., swine-erysipelas; and (2) a number of imperfectly differentiated diseases caused by ovoid bacteria belonging to the septicæmia hæmorrhagica type, or to the coli class of organisms.

The classification of the multiple types under which swine-erysipelas manifests itself is easily effected by discovering the specific bacillus in the lesions. It is thus that one has been able to successfully bring under the head of swine erysipelas lesions on the endocardium and synovial membranes of the joints, and also a number of cutaneous forms—nettle-rash, necrosis of the skin, erysipelas, prurigo, urticaria, etc.

The classification of the other "red diseases" of the pig involves numerous uncertainties. The question of the unity of the types raised by the excellent works of M'Fadyean and Preisz cannot be here discussed. From the point of view of sanitary police the problem raised does not seem to have more than a secondary importance, all the forms grouped together presenting close analogies with regard to their etiology, and appearing to justify identical sanitary measures. Under the term pneumo-enteritis (swine-fever),[2] we shall include, in order to study their prophylaxis, without expressing any opinion as to their etiological relationships, the diseases designated by the names hog-cholera, swine-plague, pneumo-entérite, swine-fever, schweineseuche, schweinepest, svinpest, peste suina, sértésvész, and sertéskoléra.

It appears to me to be necessary to study apart the prophylaxis of swine-erysipelas and that of pneumo-enteritis, and separate chapters will therefore be devoted to discussing the sanitary measures applicable to each of these infections.

I. SWINE-ERYSIPELAS.

At the present time swine-erysipelas is known to occur throughout the whole European continent. However, it has a very unequal distribution. Central Europe, the west of France, and Eastern Russia constitute the special domain of epizootic swine-erysipelas, outside of which it appears to spread with difficulty.

The difficulty with which swine-erysipelas becomes acclimatised in the northern regions is shown by the predominance of attenuated and benign forms of the disease, and by the absolute rarity of fatal cases. In Sweden and Norway only some hundreds of cases are annually

[1] Translation of a paper contributed to the Seventh International Veterinary Congress.

[2] [To avoid misunderstanding, the word pneumo-entérite throughout the remainder of the article is translated by the English name swine-fever.—J. M'F.]

reported, and as a rule the type is not severe. The figures furnished by Denmark are more imposing:—

Years:	1887	1888	1889	1890	1891	1892	1893	1894	1895	1897
Number of Cases	387	786	1019	1372	2146	796	454	3138	3462	4152

The increase shown in the statistics is due to the fact that from 1894 onwards the figures include benign cutaneous forms, amounting to about four-fifths of the total.

Great Britain is equally unsuitable for the occurrence of erysipelas in the epizootic form, and in that country it is almost exclusively under the form of bacillary endocarditis that the disease is reported. The English Commission appointed by the Minister of Agriculture to study diseases of the pig concluded from its researches that "in England swine-erysipelas has no tendency to spread, and there is no disease of the pig except swine-fever which requires to be treated under the law of 1884."[1]

The precise sanitary situation of the southern States of Europe is not well known. In Italy the disease is reported only in some provinces, especially in Emilia and Lombardy. The disease appears to be comparatively rare in the Danubian principalities, if one may judge from the importance of pig breeding in these regions.

In France swine-erysipelas is the cause of considerable loss. The disease prevails permanently in the principal centres of pig breeding; the central Plateau, Brittany, Vendée, Western Poitou, Dauphiny, and Eastern Provence are particularly attacked. One may estimate at not less than 100,000 the number of pigs which succumb annually, and the value of these animals at 5,000,000 francs at least.

The information furnished under this head from Germany is still incomplete.[2] In 1896 the annual loss was officially estimated at 4,500,000 marks; these figures, however, appear to be too low. The Departmental Veterinary Surgeon (Dr Mehrdorf) of Kœnigsberg estimated at 2,696,000 marks the damage inflicted in his district alone. The sanitary report for 1897 contains for the first time statistics relating to these diseases. In 8491 communes 33,950 cases of swine-erysipelas were reported, and 32,150 died or were killed (94½ per cent. of the animals attacked). The report, however, recognises that many cases are not reported. The disease is specially prevalent in the provinces of Posen, Kœnigsberg, Oppeln, Gumbinnen, and Bromberg.

In Saxony the total number of cases reported is very small—809 deaths in 1895, 745 in 1896, and 47 in 1897. The following figures indicate the extent to which the disease prevails in the Grand Duchy of Baden:—

Years:	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898
Number of Cases	8394	7405	3014	4458	11,656	6336	4960	4495	7769	1829	755	451

Hungary has for a long time been known as one of the principal centres of swine-erysipelas. Between 1888 and 1894 the number of

[1] Second Report of the Departmental Committee appointed by the Board of Agriculture to inquire into the etiology, pathology, and morbid anatomy of the diseases classed as swine-fever. London, 1897.

[2] Swine-erysipelas and swine-fever (Schweine-Rothlauf and Schweinepest) are treated under the law of 23rd June 1880 only since the 1st October 1898.

deaths varied between 16,000 and 42,000; in 1895 they amounted to 70,000, but it is probable that this recrudescence is only apparent, and that numerous outbreaks of acute swine-fever have been attributed to swine-erysipelas. In the same way, the sudden improvement noticed in 1897 is ascribable to the sanitary measures enforced against the same disease:—

Years:	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897
Number of Cases	22,817	53,867	25,692	42,299	28,954	21,270	23,347	92,338	28,806	11,068
Deaths:	18,774	42,300	14,475	33,898	22,549	17,473	19,563	70,043	21,306	8,500

In Russia the central provinces are highly infected. The statistics, which have been very incomplete until recently, show the following high figures:—

Years:	1882	1893	1894	1895
Number of Cases:	6,435	18,806	36,467	91,090
Deaths:	4,419	12,939	25,376	65,709

Outside of Europe only occasional outbreaks of swine-erysipelas are reported. In Africa it prevails along the shores of the Mediterranean (Algeria and Tunis). In the United States of America swine-erysipelas has been observed on various occasions (1885, 1888, 1893), but the enzootics have remained strictly limited, and have not spread locally. As in England, the authorities consider that swine-erysipelas does not cause any appreciable danger to pig-breeding, and that its prevention is rather a matter of hygiene than of sanitary police.[1]

A more minute study of the geographical distribution shows that in each of the States in which it occurs there are "swine-erysipelas districts," in which the disease prevails permanently. From these zones of "permanent infection" the disease frequently spreads into other districts, but in the majority of the secondary centres it does not tend to persist. Sometimes an epizootic breaks out in a district previously free from the disease, and in a few weeks causes great loss; sometimes the contagion spreads step by step from some old centre of the disease. In whichever of these ways the disease spreads, it rarely establishes itself on the new ground which it has conquered; it dies out locally towards the end of the hot season, and does not reappear. Sometimes, however, when swine-erysipelas is imported into a district previously free from it, it immediately becomes acclimatised, and a new centre of permanent infection is created.

In some regions swine-erysipelas occurs under attenuated forms, differing from one another with regard to their manifestations. Sometimes the lesions are internal (endocarditis, rachitis, enteritis), sometimes cutaneous (nettle-rash, necrosis of the skin, urticaria, prurigo). These accidents are observed in definite regions, outside of the districts in which the malignant type of the disease especially prevails; they have been observed in Denmark, Hanover, Saxony, Bohemia, and Luxemburg. In France such forms of the disease have been met with in the Departments of Gers, Tarn, and Tarn and Garonne,

[1] Smith, "Swine-Erysipelas from an Outbreak of Swine Disease," Twelfth and Thirteenth Reports of the Bureau of Animal Industry, Washington, 1897, p. 166.

in the neighbourhood of the great centre of infection formed by the Central Plateau.[1]

Another well-known etiological circumstance, which it suffices to mention here, is that swine-erysipelas is specially prevalent at a particular time of year. Enzootics break out in the spring time, persist during the summer, and disappear on the approach of the cold season. Finally, there occur periodically what may be called "swine-erysipelas years" (1891 and 1895), in which the number of cases throughout the whole country is double or triple the average.

In the diffusion of swine-erysipelas the majority of the methods of contagion—direct or indirect—come into play. In the regions that are permanently affected the disease is spread from one sty to another by the most varied means (manure, pollution of water); human beings and the smaller animals (cats, pigeons, mice) frequently carry the infection. The transmission of the disease is unavoidable in regions where the pigs are allowed to run about—in the courts and streets of the villages. Infection is also certain to take place in the countries where pastoral pig-breeding is practised; even if they are not kept in common herds the animals are inevitably affected by the virulent matters spread on the soil and in the water with the dejections from the diseased animals or from their dead bodies. The gathering together of pigs at fairs and markets, their sojourn in affected places (courts of inns, premises of pig-dealers), the traffic in young pigs, and the sale of the flesh of diseased animals, are other methods by which the affection is frequently spread.

The diffusion of swine-erysipelas from the permanent centres of infection is rendered certain by the exportation of diseased or contaminated animals. Young pigs are particularly dangerous, owing to the fact that they are but slightly susceptible and take the disease in a benign form. Very often when a case of swine-erysipelas is discovered in a sty the owner hurries the contaminated animals to the nearest market. The animals are sure to be sold on account of the small price asked for them, and they then spread the disease in all directions, sometimes after having infected the pigs exposed with them in the market.

Sanitary measures have a double object, viz. (1) to attack and destroy gradually the permanent centres of infection, and (2) to prevent the disease from spreading outside of these zones.

The sanitary measures usually put into force comprise, compulsory notification of the disease, isolation and sequestration of diseased and contaminated animals, destruction of carcases, sanitary supervision

[1] In the present state of our knowledge it is impossible to explain the mysterious way in which the contagion appears to spread. Why should certain countries remain unaffected although the bacillus is certainly imported into them, and although it is found in an attenuated condition in the chronic lesions, which are the only kind that it determines? What is the explanation of these regional differences in the evolution of the disease? How can one interpret these puzzling variations with regard to the certainty and the permanence of infection?

One cannot here invoke the influence of race, for English pigs imported to the Continent are decimated by swine-erysipelas. The *régime* and the manner in which the animals are kept do not play any *rôle*, for epizootic swine-erysipelas prevails both under the system of industrial breeding of Denmark and Prussia, and in the countries of pastoral breeding, where the animals are kept in large herds, as in Hungary, or in small isolated lots, as in Brittany and Auvergne. Moreover, it has been shown by experiment that the bacillus isolated from the chronic type of the disease is considerably attenuated, sometimes to such a degree that it will not kill the rabbit, or even the mouse. The question may therefore be put under another form: Why this attenuation of the bacillus in certain localities?

Under the first type the disease is enzootic; outbreaks are rare, and the disease shows little tendency to spread. Under the second type it assumes from the outset an epizootic character, and it has a tendency to spread which is comparable to that of foot-and-mouth disease or sheep-pox.

The epizootic outbreaks of swine-fever have consequences which are equally different. Sometimes the contagion dies out locally after some months or several years; sometimes it becomes permanently established, persisting indefinitely under the same type, and playing ruin with the breeding of pigs over a large country.

The following examples will serve to illustrate these general statements.

In France, where swine-fever has been definitely observed since the beginning of this century, the spread of the disease has been extremely slow. The permanent centres (Côtes du Nord 1846, Tarn 1821) have hardly increased during half a century, and some of them have spontaneously died out. It is impossible to ascertain, even approximately, the losses which it has occasioned; the disease is only reported under the sporadic form or as circumscribed enzootics.

The situation is analogous in Belgium and in Switzerland, where swine-fever occurs in isolated outbreaks, without attracting special attention.

In Germany, as in France, the disease has been recognised since the first half of this century. At the present time it prevails in the majority of the provinces, but, save in the east, the diffusion is slow, and in most cases the enzootics die out locally. The sanitary report for 1897 records 11,420 cases in 1704 communes, with 8858 animals dead or slaughtered. The districts of Breslau, Liegnitz, Posen, and Oppeln are the most severely attacked. The kingdom of Saxony, although it has been infected for a very long time, records only some dozens of cases of the disease annually (forty-seven cases in 1897).

It thus appears that in certain countries swine-fever assumes an enzootic character, with a comparatively mild course and little tendency to spread. Nevertheless, in these countries epizootic invasions may be observed. In 1887 swine-fever appeared under this form in the south-east of France, as the result of the importation of pigs from Algeria; in a few months, more than 25,000 pigs died in the single department of the Bouches-du-Rhone. Similar epizootics have been observed from time to time in the eastern provinces of Germany. In 1894 the department of Breslau lost 17,386 animals (12,515 dead and 4871 slaughtered) in consequence of the importation of black pigs from the duchy of Posen (Ulrich).

In other countries the disease has steadily continued to spread. In Holland it did not spread much till 1885, but it then extended rapidly until 1892 (9771 cases and 6922 deaths), after which it disappeared in a few months. In Denmark, where a serious epizootic prevailed in 1887, the disease ran a similar course.

Under a second type swine-fever presents itself as a permanent epizootic; here the disease becomes acclimatised at once. Great Britain and the United States furnish demonstrative examples in this respect.

In England swine-fever was discovered in 1862 by Professor Simmonds on a farm near Windsor; in 1864 Professor Brown observed

an enzootic in Berkshire (Buscot Park). Since then the disease has not ceased to spread. In 1878, at the request of several counties, and notably the authorities of Norfolk, swine-fever was scheduled as a contagious disease. The following figures show the losses which it has occasioned :—

Years:	1879	1882	1885	1888	1889	1890	1891	1892	1893
Cases:	17,074	14,763	38,798	32,241	25,885	20,092	32,369	23,957	21,662

In the United States of America swine-fever is still more prevalent. According to the investigations of the Bureau of Agriculture, the disease first appeared in Ohio in 1833. In 1858 Illinois, Ohio, Indiana, Pennsylvania, New York, and Maryland were attacked, and from 33 to 80 per cent. of all the pigs succumbed to the disease. According to the official estimates the loss amounted to 100 million francs in 1870, 403 millions in 1877, 68 millions in 1892, 100 millions in 1884, and 125 millions in 1885. It is estimated that at the present time the losses caused by hog-cholera exceed forty-five million head, representing a value of over £45,000,000. In certain States the number of deaths has been almost incredible. Between 1882 and 1890 Nebraska lost 2,711,317 pigs; in 1895 the loss amounted to twelve and a half million francs. In 1896 the losses in Pennsylvania were three million francs, and in Iowa fifty million.

Observation has furnished little information with regard to the methods of contagion. One does not here meet with the etiological peculiarities which belong to swine-erysipelas. Swine-fever appears at all seasons, and strikes without distinction animals of every age and breed.[1]

What is the explanation of the sporadic form observed in some countries, and why in other countries is there a tendency to sudden and rapid diffusion of the disease?

One explanation immediately presents itself to the mind. Some populations are more resistant to infection than others; whether this relative immunity be due to the animals themselves, or to qualities of their environment, it is sufficiently manifested by the fact that certain countries are not readily invaded by the epizootic.

The history of swine-fever, however, shows that the regions which are ordinarily free from the disease are apt to be seriously invaded by it; the epizootic of the south-east of France and the Dutch and Danish epizootics are convincing with regard to this point. A still more striking example is offered to us at the present moment.

Until 1895 Austria-Hungary remained almost free from swine-fever. This immunity of a large country seriously exposed to the risk of contagion by its eastern and southern frontiers was difficult to explain, and some did not hesitate to invoke the circumstance as a convincing proof of the so-called "territorial immunity."

At the end of April 1895 some cases of swine-fever were discovered in the market at Köbanya-Steinbruch, and during the month of

[1] The etiological influence of race has been often invoked, but at the present time it cannot be sustained. In the observations made in Hungary the local breeds furnished 44 per cent. of the deaths, while the Berkshire crosses furnished only 15·5 per cent., but in England the Berkshires are very susceptible. The influence of age is more appreciable, young animals (under a year old) being more readily attacked; on the other hand, old animals more frequently suffer from the chronic form of the disease.

May the daily number of deaths gradually rose from 42 to 100. On the 27th May a Ministerial Order interdicted the exposure of native pigs in the market, but pigs from Servia, which was considered to be free from the disease, were still admitted. On the 28th and 31st May two pigs from Servia showed symptoms of acute swine-fever, and on 1st June the importation of pigs from that country was interdicted.

At the same time that the disease decimated the pigs where it had broken out, it spread with surprising rapidity to Lower Austria, Moravia, Galicia, and the whole of Hungary. The following figures, which relate to Hungary exclusively, will give an idea of the rapidity with which the disease spread. The number of Communes attacked was seven on the 12th June, eighty-seven on the 26th June, 327 on the 31st July, 535 on the 28th August, 736 on the 25th September, 921 on the 30th October, and 1000 on the 20th November. During the last six months of 1895 Hungary alone lost 365,444 pigs, of which 337,018 died and 10,376 were slaughtered. In 1896 there were 670,835 cases, with 639,765 deaths; and in 1897 the contagion struck 514,291 pigs, of which 360,838 succumbed.

This shows what is the real value of territorial immunity, and what disasters may flow from the false security which it engenders.

Another reply must therefore be given to the question. The differences observed are not connected with the resistance of the population exposed to contagion; they are certainly ascribable to variations in the quality of the virus.

The researches of Smith, M'Fadyean, Preisz, and Karlinski have shown the diversity of the biological characters and pathogenic properties of the bacteria which have been isolated. It is possible, as some think, that two quite distinct affections are grouped under the term swine-fever, and that this is the explanation of the multiplicity of the types of contagion in different epizootics. From the special point of view of practical prophylaxis, these distinctions will not present an immediate interest until the different varieties of contagion have been exactly determined for each of the forms differentiated, and until precise methods have been formulated for the differential diagnosis of each of them.

The prophylaxis of swine-fever is exclusively a matter of sanitary police. The methods of immunisation recommended have hitherto only yielded doubtful or insufficient results where they have been put into practice. It will suffice to mention here the experiments with sero-therapeutics made in Hungary, and to recall the interesting researches of Peters and Schweinitz in America, and those of Perroncito and Bruschettini in Italy.

Two different sanitary systems may be applied to swine-fever, the one extending merely to a sanitary supervision of the diseased and contaminated animals, the other involving general slaughter of diseased animals and of those that have been exposed to the contagion.

It is certain that the first system may triumph over the disease even when that prevails in the epizootic form, but it will prove efficacious only in countries that possess a vigilant administrative police and a thoroughly organised sanitary service. The measures to be put into force are analogous to those which may be advised against swine-

erysipelas, but marking of the diseased and contaminated animals and permanent isolation of them are here indispensable, on account of the frequent occurrence of chronic lesions. Moreover, the economic advantages of dealing with the disease in this way are more apparent than real; if the limited call for sanitary action does not necessitate any sacrifice on the part of the State in the shape of compensation, the method is nevertheless very burdensome for the owners.

In countries where pastoral breeding is carried out it would be impossible to insist on prolonged sequestration without ruining the industry. From a sanitary point of view the method is difficult to apply by reason of the difficulty of exercising a rigorous supervision of suspected animals, and it is important to remember that the contagion may be maintained or spread by occasional animals suffering from the chronic form of the disease.

Experience indicates that a sanitary supervision is unavailing against extensive epizootics of swine-fever. Without citing the example of the United States, nor yet that of Great Britain, which for different reasons would prove nothing in this respect, it suffices to observe that Austria has been obliged to seek a more perfect system in order to overcome the disease.

From the economic point of view the method of stamping out appears to be an extremely serious one. General slaughter of diseased and contaminated requires compensation; it is even in the interests of the State that compensation should be liberal, so that the owner may not have any interest in concealing the disease, if one desires to completely and quickly suppress outbreaks. It ought to be observed, however, that one has here to do with animals that are always useful for the butcher, and that one can therefore recover at least a part of their value. On the other hand, the losses which result from the deaths and from the depreciation of the survivors are so considerable that it is often economical to carry out the slaughter of all the animals in the infected premises. From the sanitary point of view the method of general slaughter cannot be approved without some reservations, such as I formulated when Great Britain, with praiseworthy determination, began the campaign which we all follow with interest. The method is theoretically perfect when it is applied to diseases produced in a definite manner by immediate contagion, such as rabies and pleuro-pneumonia, but in the case of swine-fever the method is much less certain, for in the latter disease indirect methods of contagion play a rôle the extent of which cannot be estimated, and the prevention of which is uncertain.

Since 1894 Great Britain has rigorously applied the system of stamping out. The number of animals slaughtered was 56,293 in 1894, 69,931 in 1895, 79,586 in 1896, 40,432 in 1897, and 43,756 in 1898. The number of outbreaks confirmed fell to 6305 in 1895, 5166 in 1896, 2155 in 1897, and 2514 in 1898. The situation, as one sees, has been notably ameliorated, but the ultimate victory for which we hope will necessarily require prolonged efforts and heavy sacrifices.

It is also the method of general slaughter to which Austria proposes to have recourse in order to combat the disease. The Bill submitted to Parliament extends to swine-fever (Schweineseuche and Schweinepest) the regulations which have been so successfully

applied against pleuro-pneumonia by the law of 17th August 1892.[1]

The application of such grave measures in a country invaded by the epizootic type of the disease is attended with considerable difficulty. In England the disease is mainly kept up by old animals which, without being suspected, are affected with the chronic form of the disease; such animals are sent to market and afterwards give rise to new centres of disease. The disease is also spread from farm to farm by dealers in pigs, and this method of contagion is still more difficult to counteract.

Although sanitary action is difficult and costly when it is exerted against the epizootic type of swine-fever, it is not attended with serious difficulty when it is applied to the stamping out of a few scattered outbreaks. Here general slaughter appears to be theoretically the most efficacious and economical method. We have seen that sanitary supervision is often insufficient and dangerous; marking and permanent isolation of all contaminated animals, which alone would constitute an adequate safeguard, are annoying for the owners.

In all recent centres of infection, when the contagion is limited and the disease is detected early, immediate slaughter of all the animals that have been exposed to infection is the method that ought to be preferred. This plan is more difficult to carry out in the case of old centres, in districts where pastoral breeding is carried on, and when the zone of infection is extensive and difficult to determine. In these cases sanitary supervision (with isolation of diseased and suspected) enables one to determine exactly, and then to check, the centres of infection, while complete eradication of the disease would be hastened by subsequently resorting to partial or general slaughter, according to the particular circumstances of the place.

From a study of the epidemiology of swine-fever, one may draw the interesting conclusion, that not one of the great epizootics of which the history is known was done to the extension of an old indigenous centre—all have been started by the importation of diseased animals. The French epizootic of 1887 and the Hungarian outbreak were assuredly started in this way, and it appears to be established that the disease had a similar mode of origin in Great Britain and the United States.

If the importation of a "reinforced" virus is the condition precedent to an epizootic outbreak, every effort ought to be made to prevent such a thing happening. Countries that are still free from the disease, or which have it only in the sporadic form, ought to prohibit the importation of animals from regions in which the disease prevails in the epizootic form.

[1] The allusion here made is to a Bill introduced by Count Thun in the Austrian Parliament on the 20th October 1898. A special law was promulgated on the 2nd May 1899, ordaining the slaughter of diseased and contaminated animals, with temporary compensation.

CANINE AND FELINE SURGERY.[1]

(*Continued.*)

By F. HOBDAY, F.R.C.V.S., Royal Veterinary College, London.

Operations on the Thorax.

Paracentesis Thoracis (*tapping the chest*).—Unless absolutely necessary, it is not advisable to fix the patient before performing this operation, but to merely have it quietly held in the standing position. Any pressure on the throat or chest is dangerous, and death is very apt to suddenly ensue from asphyxia if the patient struggles or falls heavily to the ground. The operator carefully removes the hair from, and disinfects, a spot about an inch above and behind the point of the elbow on the right side; a fine trocar and canula are introduced subcutaneously for a short distance, and the point passed between two of the ribs (usually the sixth and seventh, or seventh and eighth). The trocar is then withdrawn and the canula inserted as far as necessary, the fluid contents of the chest being allowed to escape slowly. Any material blocking the end of the canula and retarding the flow must be removed by the careful re-introduction of the trocar or a sterilised blunt probe.

Symptoms of collapse must be watched for, and the amount of fluid withdrawn left entirely to the discretion of the operator.

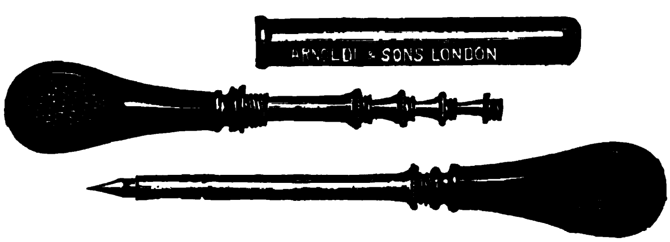


FIG. 52.
Trocars and canulæ, various sizes, nested.

Solution of iodine, chinosol, or some antiseptic may or may not be injected, after which the canula is carefully and slowly withdrawn.

The seat of puncture is dried with aseptic cotton wool and covered with iodoform (or orthoform) and collodion.

The prognosis of these cases is usually unsatisfactory, as the relief given is only temporary, and more fluid is again formed within a comparatively short time. Potassium iodide administered internally is supposed to have a beneficial effect in preventing the re-formation of fluid and in aiding the absorption of any that may be left, quinine and strychnine being also recommended to give tone to the system; but cases of complete recovery are few and far between.

[1] Copyright by the author.

Operations upon the Abdomen and Digestive Organs.

Paracentesis Abdominis (*tapping the abdomen*).—The best situation to choose for this operation is the linea alba, or as close to it as possible, an inch or so behind the umbilicus. The patient is fixed on its side, and, after the removal of the hair and thorough disinfection of the part, a small trocar and canula are introduced subcutaneously for about half an inch and turned cautiously into the abdomen. Care must be taken not to injure any of the abdominal organs. The method of procedure is the same as already described in the preceding paragraph (paracentesis thoracis); very large quantities are sometimes removed.

Prognosis must be guarded, but the prospects are much better than in the case of removal of fluid from the chest. The life of the patient may be saved for a much longer time, and occasionally permanent benefit results.

Laparotomy.—This consists in opening the abdominal cavity with a view to exploring or operating upon some of its internal organs. On the day preceding any major abdominal operation the patient should be bathed and washed in some disinfectant solution, no solid food being given for about twelve hours before. After carefully shaving, removing grease from the skin with ether, and rigidly disinfecting the parts, administer an anæsthetic and fix the animal on its back with the limbs well extended. Incise the skin in the median line, the actual situation chosen depending upon which organ is to be operated upon. Carefully arrest all hæmorrhage either with artery forceps or tampons of aseptic wadding, puncture the peritoneum, insert a director, and, with the aid of a scalpel, make an incision of the required length.

After doing whatever is necessary to the internal organs, carefully remove all blood from the neighbourhood of the wound, suture the peritoneum with fine silk, the muscles with silkworm gut, and the skin with silk or catgut. The peritoneum and muscles may be taken together, and some practitioners suture all three layers (peritoneum, muscles, and skin) at once, but this method cannot be as safe as if they are taken separately. A continuous suture may be used for the peritoneum, but interrupted sutures are unquestionably the best for the muscles and skin, as, if septic infection takes place, it is much more convenient for the cleansing and dressing of the wound.

In order to complete the operation the exterior is carefully dried with aseptic wadding and covered with iodoform (or orthoform) and collodion.

Occasionally in large dogs, where a long incision has been made, a bandage is useful over this to give support to the edges of the wound, but in the majority of cases this is not necessary and only forms a source of annoyance and irritation to the patient. Care must be taken to keep the animal perfectly quiet for about ten days, and on no account to allow it to go up and down steps, or to jump from a height; neglect of these precautions is liable to lead to the re-opening of the wound and escape of the intestines.

Prognosis is excellent, provided rigid attention is paid to antisepsis; and, as a general rule, beyond the removal of the cutaneous sutures four or five days later, the wound requires no further attention.

Hernia may result in about four or five per cent. of cases, but is generally traceable to some neglect of detail, and now and then a buried silkworm gut suture gives rise to irritation, and requires to be removed. These conclusions are based upon more than 120 consecutive cases.

The median line is preferable wherever it can be conveniently used, because, (1) there is less tissue to cut through; (2) less hæmorrhage, the blood-vessels here being few and small; (3) if, unfortunately, pus does form in the abdomen, it has a better chance of draining away; and (4) healing is very rapid, provided that septic infection does not take place.

Gastrotomy. — This operation, consisting in the opening of the stomach, is performed for the removal of foreign bodies such as meat skewers, sticks, stones, hat pins, etc., which cannot be got rid of by the aid of an emetic or a purgative, for ulcers of the stomach wall, and for the removal of foreign bodies from the lower part of the œsophagus. The patient is prepared and laparotomy performed as already described, the site of incision chosen being on the median line, just about 1 or 2 inches below the extremity of the sternum. The stomach is drawn into the wound and surrounded by lint or cloths soaked in antiseptics, the foreign body being brought close up against a portion of the wall where blood vessels are small or absent, and an incision made directly over it. Usually, as soon as the stomach is punctured a certain amount of gas rushes out and carries with it some of the contents; this may be guarded against by making a preliminary puncture with a fine trocar and canula. Any fluid that does escape must be immediately soaked up before it reaches the peritoneum.

The foreign body is extracted, the internal edges of the wound are carefully cleansed with antiseptic solution, and a double row of sutures inserted. The first row passes through the whole of the coats, the second sutures being of Lembert's pattern and inserted through the serous and muscular coats at some little distance from the edges of the wound, so that when drawn together they completely hide the latter, and thus act as a double protection against the exit of fluid from the stomach.

With a gastric ulcer the chief trouble lies in the difficulty of making an accurate diagnosis; the operative procedure consists in making an elliptical incision so as to remove all the necrosed edge and drawing the sound portions of the wall together as already described. The abdominal cavity must be examined for any material which may have escaped, this being removed with antiseptic swabs.

Foreign bodies in the lower part of the œsophagus usually consist of large pieces of bone, gristle, etc., which have been greedily swallowed, and which cannot enter the cardiac orifice of the stomach and cannot be pushed down with the probang or brought up by an emetic. In one case we were successful in removing a very large piece of gristle by means of a strong slender pair of dressing forceps passed up the œsophagus through the stomach wall when all attempts to move it with the probang had failed. The method of opening the stomach and closing the wound is as already described.

The after-treatment consists in keeping the patient as quiet as possible, allowing nothing but a little water, or milk and water, containing three or four grains of boric acid, during the first forty-eight hours, nutrient enemata of beef tea or mutton broth being given per rectum every six or eight hours. On the third day a little milk or beef extract may be allowed in addition, and at the end of the fourth or fifth day some finely minced meat or fish. Care must be taken during the first fortnight that the stomach never becomes distended, on account of the risk of tearing out the sutures.

As regards sequelæ, the prognosis must always be grave, as the operation is a major one, but if the diagnosis is certain and the patient not too debilitated it ought certainly to be adopted as giving an otherwise doomed patient another chance.

It is really wonderful how little inconvenience dogs appear to suffer from wounds caused by meat skewers, hat pins, needles, etc., in the stomach, even when no antiseptic or surgical precautions are taken. During the past few years quite a number of cases have been recorded by Wolstenholme, Perryman, Brookshanks, Tutt, R. Gillard,[1] Woodruff,[2] and others,[3] in which foreign bodies have been carried for a length of time in the stomach of the dog or cat, without causing any more alarming symptom than the formation of an abscess in the side.

Operation for Intussusception of the Intestine.—Intussusception of the intestine is most commonly met with in young animals, although it is by no means of very rare occurrence in adults. It is diagnosed without much difficulty in thin patients, being perceptible through the abdominal walls as a soft tumour-like swelling along the course of the intestine, but in fat animals it is very difficult to differentiate between this and other obstructions, the symptoms being very similar. The surgical method of affording relief consists in the performance of laparotomy, and the replacing of the gut into its natural situation by means of the fingers. If the intussusception is of recent origin this can be done without any difficulty, but if it has existed for some time adhesions will have formed and the outlook is much more serious. If these adhesions can be broken down without materially injuring the bowel wall, this should be done; if not, the whole piece must be excised (*see* enterectomy).

Operation for Impaction of the Intestine.—An obstinate impaction of the intestine is particularly met with in shooting dogs, being usually ascribed to their over-indulgence in game bones. Three cases have been met with by the author during the past twelve months, in two of which the animals (retrievers) had passed no fæces for at least three weeks.

The obstruction usually occurs in the colon, and it may extend upwards for a considerable distance into the small intestine. In one of the retrievers above-mentioned fully a foot of intestine was involved by a mass as hard as a stone, the small intestine in front being enormously dilated and full of semi-fluid fæculent material.

Surgical aid is rendered after all efforts to remove the impaction by

1 "Veterinary Record," Vol. VII., pp. 187, 295; Vol. X., p. 206; Vol. XI., pp. 376, 434.
2 "The Veterinary Student," Vol. I., No. 2, p. 2.
3 "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 254; Vol. X., p. 360.

medicines given by mouth or rectum have failed. The simplest plan consists in the injection of melted lard or warm oil per rectum, and the removal of as much as possible, bit by bit, with the fingers or a blunt spoon. This can be done to a certain extent, but often the lump is out of reach, and matters become more serious. Laparotomy must be performed and the obstructed bowel massaged and kneaded gently but firmly, until its contents break up into fragments of sufficiently small size to be passed on into the rectum ; they are then removed by an assistant.

The process of kneading must be done very patiently with the ends of the fingers and thumb, great care being taken to avoid injury from the nails ; it is a good plan to try first at one end and then at the other, gradually working towards the centre, or any place that feels softer than its surroundings.

A third plan consists in opening the bowel and removing the obstruction in that way (*see* enterotomy), the operation being rendered more risky than in an ordinary case on account of the large accumulation of fluid fæculent matter, and the lax, debilitated condition of the serous and muscular coats of the intestine ; the latter in particular rendering the insertion of sutures without tearing a matter of very careful and delicate manipulation.

The prognosis when the hardened fæces can be removed by the spoon alone is good, the only after-treatment necessary being the injection for a few days of some emollient antiseptic. When the case has progressed so far that laparotomy or enterotomy have become necessary, the prognosis is grave, because, as a rule, the patient is debilitated from inability to take proper nourishment and from absorption of septic materials. Death from collapse may occur within a few hours afterwards, and in one case met with death suddenly occurred four days afterwards from invagination and strangulation of the bowel, a large piece of the healthy portion having tunnelled its way into the dilated portion where the obstruction had existed, before the latter had had time to contract and recover its tone and normal size.

Enterotomy.—This operation, which consists in opening the intestine, is performed in order to remove any foreign body which may have lodged there. The animal is prepared, secured, and anæsthetised in the same way as for laparotomy ; the abdomen is incised, the piece of intestine containing the foreign body brought into view, the bowel being lightly clamped above and below in order to prevent exit of intestinal matter when the incision is made. Pieces of rubber tubing held tightly around the bowel with artery forceps improvise very well for the clamps. Aseptic lint or cloth is placed around the bowel to prevent it from touching anything dirty, and an incision is made in a longitudinal direction over the foreign body in that part of the intestine which seems to be the least congested. If thought desirable an attempt may be made to pass the foreign body along to a more favourable spot for the operation. The obstruction is then extracted, the edges of the wound and the intestine above and below as far as the clamped portion being cleansed and disinfected. Lembert's sutures (*see* Fig. 26, p. 100) are inserted, and the wound in the abdominal wall treated as after an ordinary laparotomy.

Careful dieting and after-treatment is necessary, as already

described after gastrotomy. If the patient has not already become weak, the prognosis, although always grave, may be considered fairly good.

During the last two years, cases of recovery have been reported by Vennerholm[1] and Pauer,[2] both being cases in which the foreign body was situated in the rectum.

Enterectomy and Anastomosis of the Intestine.—In certain cases in which the bowel has become gangrenous or injured, owing usually to the presence of a foreign body or some abnormal growth, the only chance of saving the patient's life depends upon the excision of the diseased portion and the union of the cut ends. This operation, although of course a very serious one, has now regularly taken its place in human surgery, and that it can be successfully performed in healthy dogs and cats has been demonstrated many times. The chief difficulty in veterinary practice seems to be to make a sufficiently accurate diagnosis early enough, *i.e.*, before gangrene has set in or the patient has become exhausted. In our own experience the results have not been good, but in each case the patient was very much exhausted when brought for treatment.

For an enterectomy the preliminary preparations are the same as for laparotomy; for the intestinal anastomosis careful suturing alone may be done, or resort may be had to certain mechanical aids such as those afforded by cones, discs, buttons, bobbins, etc., made of metal, decalcified bone, carrot, turnip, potato, etc.

The abdomen is opened in the usual way on the median line or flank according to the position of the obstruction, and the offending portion of intestine sought for and withdrawn, being pulled through a hole in a cloth which has been carefully soaked in warm antiseptic and packed around with antiseptic lint or wadding. The contents of the bowel are forced back by pressure with the fingers and thumb for about 6 inches above and below the diseased part and clamped. Special instruments are designed for the purpose; they can be improvised by fixing pieces of rubber tubing around the gut, or (Dr Maunsell's suggestion) by safety pins padded with sponge or wadding.

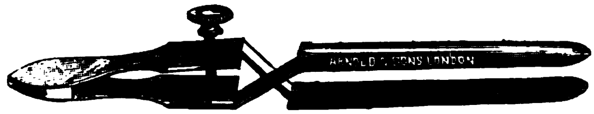


FIG. 53.
Bowel clamp (Makin's).

The branches of the mesenteric artery supplying the region to be excised are taken up with artery forceps and ligatured, the bowel being cut through with scissors held at right angles to its lumen. The lumen is then swabbed out as far as the clamps with wadding soaked in some fluid antiseptic. The two serous surfaces are brought into contact by interrupted sutures of Lembert's pattern inserted about a fifth of an inch from the edge and a sixth or an eighth of an inch apart, particular care being taken not to penetrate the mucous

1 "Veterinary Record," Vol. X., p. 327. Mayall's Translation.
2 "Veterinary Record," Vol. XII., p. 110.

coat of the bowel. A very fine round needle and silk No. O or OO should be used.

Of the various mechanical devices for facilitating the anastomosis of the divided ends of the intestine after enterectomy, the metallic button invented by Murphy of Chicago is probably the one which has attracted the most notice amongst surgeons during the past few years. The advantages claimed by Dr Murphy are that: (1) the button dispenses with the need of sutures; (2) the possibility of non-apposition is prevented; (3) the danger of sloughing is avoided; (4) the too rapid digestion of the catgut sutures is prevented; (5) the operation being more rapid, prolonged anæsthesia is avoided; (6) the great ease of the operation renders the instrument as safe in the hands of the everyday practitioner as in that of the most dexterous specialist.

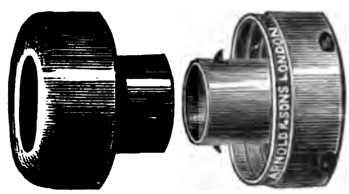


FIG. 54.
Murphy's button.

All who have used it have not found these advantages. After a course of experimental work on dogs, Jordan speaks of "the danger arising from the presence of the large metallic button, and the risk of gangrene spreading further than is necessary, in Murphy's operation." Harrison Cripps[1] speaks very strongly against its use in human surgery, his experience leading him to directly opposite conclusions to those of Murphy.

It is placed and fixed in position as follows: The male half of the button is placed in the distal end of the bowel, and the female half in the proximal end, being held there by an assistant; a continuous running thread is passed in and out completely around each end of the intestine in a manner similar to the "puckering string" or "draw string" of a bag; the silk is then drawn up around each stem of the button and tied securely. The two halves are steadily and firmly pressed together, so that the two serous surfaces come in direct contact. In from a week to a fortnight sloughing occurs of the parts included within the button, and the latter is passed through the bowel, union of the two serous surfaces having occurred in the meantime.

Jordan,[2] in India, performed enterectomy experimentally upon fifty-nine pariah dogs by various methods, the one which gave the greatest percentage of success being as follows: Two hollow cylinders, each three-quarters of an inch long, were made either from the decalcified femora of geese or turkeys, or from fresh carrots, turnips, or potatoes, and bevelled off at one end so as to form a hollow truncated cone, the apex being less than, and the base the diameter of,

[1] "Ovariotomy and Abdominal Surgery," p. 281.
[2] "The Lancet," October 1897, p. 1098.

the lumen of the bowel. Each cone was furnished with two sutures, which were passed through its wall from the apex to the base, one on each side, a big knot at the apical end preventing the suture from being pulled through the cone. The apex was then inserted and the "cone sutures" passed through all the layers of the bowel an eighth of an inch from the cut margin, one at the mesenteric attachment and the other at the opposite side of the gut. The other cone being

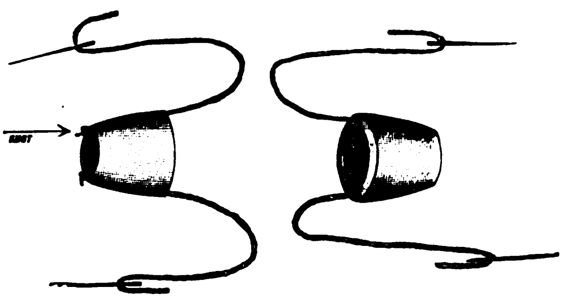


Fig. 55.[1]
Cones with sutures and needles attached.

similarly passed, an assistant approximated the ends of the bowel, and the corresponding pairs of sutures were tied moderately tightly. The ends of the sutures were cut as short as possible. The cut ends of the gut were thus fixed in contact, slight inversion of the ends occurring at the sutures. A continuous "double turned" suture (*see* Fig. 57) was now commenced on the under surface of the bowel about one-third of an inch from the mesenteric attachment; especial care

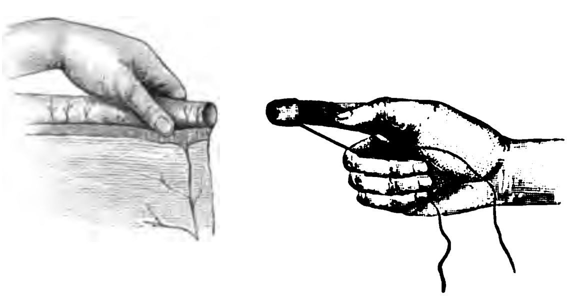


Fig. 56.
Mode of insertion of cone.

was paid to the first four stitches to ensure that the knot of the "cone sutures" was buried beneath the line of the continuous suture, the needles here being inserted a little farther from the cut margins. The assistant, holding the bowel at the apex of each "cone" between the thumb and fingers, kept the cut ends of the gut in view (otherwise excessive inversion occurred during the suturing), and gradually rotated the bowel back to its original position as the suturing pro-

[1] **For this and the following two figures I am much indebted to "The Lancet."**

ceeded. Especial care must be taken to bury the "cone suture" knots, or peritonitis is apt to ensue. As each "double turn" (*see* Fig. 57) of the continuous suture was in process of being tightened, the assistant, with the closed blades of a pair of scissors applied on the flat, or other instrument, inverted the margins of the bowel and kept them so until the double turn was drawn sufficiently tight to invert them permanently. When the gut had been sutured all round, the two ends of the suture were tied with a reef knot; the bowel was

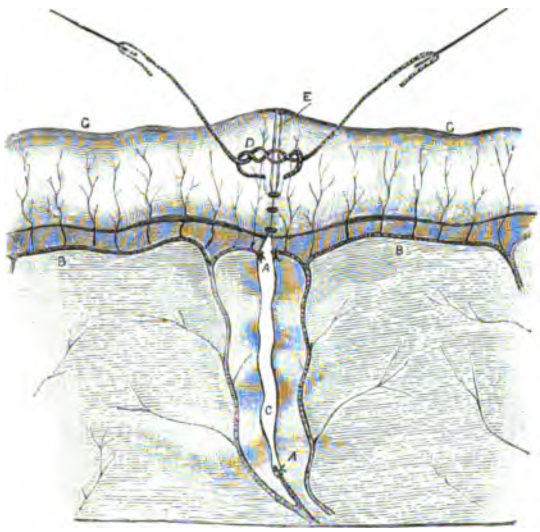


Fig. 57.
Operation half completed (dog's bowel).

AA. Arteries ligatured; BB. Arterial loops; C. Gap in mesentery; D. Double turn; E. Cut margins of gut; GG. Gut.

carefully cleansed and the line of resection inspected, to ensure that the edges were everywhere inverted. The mesentery was drawn together with a continuous suture. The gut was then bathed in hot antiseptic water and returned, the abdominal wall being treated as already described for an ordinary laparotomy.

Thirty-two dogs were operated upon by this method, pieces of from 4 to 13 inches being excised. Only two deaths occurred, and one of these might reasonably be attributed to other causes than the enterectomy. It must not, however, be forgotten that these were comparatively healthy animals, none of them suffering at the time from disease of the intestine.

The sequelæ as reported were excellent, the animals afterwards rapidly putting on flesh, but Mr Jordan does not appear to have kept them under observation for more than about six months to see whether or not stricture resulted.

The after-treatment consisted in dieting with milk for the first two days, the dogs being allowed as much as they would drink; for the next four days minced meat and boiled rice were substituted, and they were then allowed to eat anything.

Excision of the Spleen.—Occasionally large tumours are met with in

the spleen, necessitating, if the patient's life is to be prolonged, complete or partial extirpation of that organ.

Removal of the whole of the organ is a very serious operation, both at the time of operating and as regards its sequelæ, death from marasmus often following within twelve months.

Mr Martyn Jordan, however, has shown[1] by an experimental research into the effect of partial excision upon healthy dogs that excellent results can be obtained.

The chief untoward results to be looked for at the time of operating are those of death from hæmorrhage or shock; the former must be guarded against by careful clamping and ligaturing of every vessel along the splenic omentum or those which supply the portion to be excised, and to avoid the latter the operation should be performed as rapidly as possible, hypodermic injections of stimulants being at hand for immediate use if required.

For extirpation of the whole organ, the patient is prepared, secured, and operated upon as in an ordinary laparotomy, the incision being made on or near to the median line, about an inch behind the sternum. The spleen is then sought for and brought as much out of the orifice as necessary, each vessel, however small, being clamped or ligatured in two places before being cut through, after which the organ is removed.

In six cases in which Mr Jordan removed the whole spleen, "all the dogs suffered greatly from shock and there were three deaths," one being from marasmus and two from shock.

For partial excision Jordan recommends the following method of continuous ligature, by which he obtained a practically bloodless section: "A long needle threaded with fairly coarse silk twist 1½ ft. long is inserted on the inner or under surface about half an inch from the edge or border and passed through the thickness of the spleen, emerging on the outer or upper surface about the same distance from the edge; the ligature is drawn through until the ends are equal; the free end is brought up round the border of the spleen and a double turn made with the two ends and drawn as tightly as possible, this turn being kept over the exit of the needle. The needle is then passed back through the spleen on the occluded side of the organ as close to the line of ligature as possible and an eighth of an inch from the edge or border side of the turn; this being done in order that the next loop shall include the spleen where the needle has previously passed through, so that any oozing along this track should be stopped when the loop was drawn tight. The needle is then re-passed through the spleen from the under to the upper surface half an inch further on, and a double turn again taken and drawn tight. Continuing in this way the spleen is traversed. A reef knot is then tied and the ends cut short. The occluded end of the spleen is then cut through close to the line of the ligature."

Interrupted, instead of continuous, interlaced ligatures are sometimes used.

Following out his method of continuous ligature, Jordan had twenty-one successes out of twenty-two cases, the animals being Indian pariah dogs varying in ages from a month upwards. In nineteen of them the lower half of the spleen was excised without a single fatality or noticeable disturbance afterwards; in the remaining three, in which

1 "The Lancet," 22nd January 1898, p. 208.

the upper half was excised, all the animals showed great constitutional disturbance, and one death occurred from shock. This authority concludes that it is the removal of the upper half of the spleen which is full of danger on account of the risk of shock and after hæmorrhage, and that it is much more difficult to operate upon than the lower half.

Removal of Tumours from the Abdominal Organs.—Diagnosis of tumours of the abdominal organs can usually be made with certainty in thin emaciated patients, but in fat animals it is often a matter of difficulty. The liver and spleen, and the uterus in the case of the bitch, are the organs most commonly affected.

Tumours of the liver are usually very vascular, and their removal is accompanied by hæmorrhage.[1] If of any size and without definite pedicle, the clam and a fine sharp iron or heated knife used very carefully form the best instruments for their removal; the results are not satisfactory if the tumour is at all imbedded in the liver structure. With tumours of the spleen and uterus, as a rule, it is the wisest plan to excise the whole of these organs if their structures are at all deeply involved. These operations are described later.

In all cases the principles of operation are the same. Rigid antiseptic precautions must be adopted, and laparotomy performed under anæsthesia; the tumour is then sought for, and removed by ligature and the knife, or whatever way is deemed advisable by the operator, in order to get as little hæmorrhage as possible, the abdominal wound being sutured and treated in the usual way.

Operation for Hernia.—The hernias commonly seen in the dog and cat are umbilical, abdominal, and inguinal. Scrotal, perineal, and femoral are met with, but are comparatively rare. Care must be taken to differentiate between tumours and abscesses occurring in

FIG. 58.
Tumours in inguinal region
(for comparison with next figure).

FIG. 59.
Inguinal hernia.

these regions and hernia. In some cases this is by no means an easy matter, even to those who have had considerable experience. In hernial sacs one must endeavour to trace the form of the herniated

[1] Nelder and Hobday, "Journal of Comparative Pathology and Therapeutics," Vol. XI. p. 251.

organs by careful manipulation between the finger and thumb, and if there is any doubt about the matter the patient should be again examined after a course of purgative medicine and fasting.

Möller[1] states that inguinal hernia only occurs in bitches which have already borne young, but between the years 1896 and 1899 we have met with four cases in females which have never been lined by the dog. It is most frequently met with on the left side. As a rule, in these cases, the contents of the sac consist of one or both horns of the uterus; frequently, in addition, one finds intestine and omentum. In one case met with in April 1896,[2] a small Manchester terrier bitch, with a double inguinal hernia, had in the right sac a portion of the small intestine, the pancreas, omentum, bladder, right horn of the uterus, the cæcum, and even a portion of the rectum. Sometimes a single horn of the uterus is found to be herniated in each inguinal region, and occasionally one or two fœtuses are present. In one instance met with by the author a fox-terrier bitch was operated upon for an inguinal hernia containing a pregnant horn; the fœtus was removed, and the horn afterwards excised, the animal suffering so little disturbance that she gave birth to a puppy in the ordinary way seventeen days later.[3]

The principles of surgical treatment are the same in all cases, and consist in the return of the organs to their normal situation, and the adoption of steps necessary to retain them there. If a general anæsthetic is used the patient is placed on the operating table in the

FIG. 60.
Photograph showing suitable position for operating upon inguinal or umbilical hernia.

abdominal posture, and afterwards turned on to its back or side as the operator may consider the most convenient; if a local anæsthetic is sufficient the animal is at once placed in the most convenient position for the performance of the operation, and the anæsthetic applied. Rigid antiseptic precautions are always necessary with regard to the instruments, the parts to be incised, and the operator's fingers.

In *Umbilical Hernia* the organ most commonly out of place is the omentum; if return is possible this is done after the skin has been incised directly over the centre of the swelling. The edges of the dilated umbilical ring are lightly scarified, and then drawn together with silkworm gut sutures, the skin being united with aseptic silk, and the wound coated with collodion and orthoform or iodoform. Strap-

[1] Möller's "Surgery" (Dollar's translation), p. 258.
[2] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 171.
[3] "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 153.

pings of adhesive plaster or a bandage may be applied if extra support is considered necessary. In cases where the omentum has become adherent to the edges of the ring, a separation must be effected by the scalpel. Sometimes a single solution of the difficulty consists in excising a portion of the omentum, and returning the remainder into the abdomen before suturing the ring as mentioned above.

With an *Abdominal Hernia* an incision is carefully made down to the protruding organs, which are returned by gentle pressure, the muscles being lightly scraped at the edges and sutured with silkworm gut, and the skin wound being sutured with silk and treated as in the case of the umbilical variety. A bandage is always advisable if the rent in the abdominal wall has been at all a large one.

With *Inguinal Hernia* there is sometimes a little trouble. An attempt should always be made to reduce the hernia by gentle pressure under a general anæsthetic when the parts are thoroughly relaxed. Whether this can be effected or not, an incision is made through the skin directly over the hernial sac, care being taken not to penetrate this, in order to avoid making an opening into the peritoneum. If the organs have not been returned another attempt may now be successful, particularly if the exterior of the sac be carefully separated from the surrounding skin by means of a scalpel handle or some blunt instrument. The extremity of the sac is seized with a pair of pressure forceps (Spencer Wells' or Pean's artery forceps answer admirably), and the sac itself twisted slowly round until it forms a kind of pedicle, around which a ligature of aseptic silk or gut can be placed. The lower portion of the sac is then cut off, and the external wound is sutured and treated on aseptic lines. If very much dilated the inguinal ring should also have several sutures drawn across it.

In some cases of inguinal hernia, however, the sac has to be opened and its contents exposed before reduction can be effected. The greatest care must now be used to avoid septic infection. After the organs have been returned the inguinal canal must be sutured with silkworm gut, a pressure pad of aseptic wadding being applied or not according to discretion, and the external wound sutured.

At times it is found necessary to incise the inguinal ring before the organs can be returned, and for this purpose a special bistoury with only a very small portion of its edge sharpened is cautiously used.

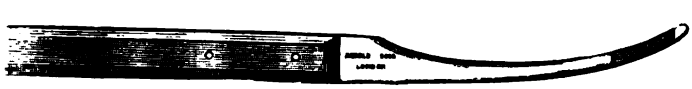


FIG. 61.
Hernia bistoury.

At other times some portion of the herniated organs, particularly in the case of omentum or uterus, has to be excised; this is best done with the scalpel after applying a ligature, the stump being sutured to the inguinal ring or returned into the abdominal cavity.

The decision as to whether a bandage should be applied here or not must be left to the operator's discretion; in some cases it is necessary, in other cases, where the patient is of an irritable temperament or the weather is very warm, it is apt to do more harm than good.

Scrotal Hernia is fortunately rare, as it is a condition which it is very troublesome to permanently relieve unless castration is allowed to be performed at the same time. If this is done matters are greatly simplified, as the prolapsed intestine is carefully returned, and an

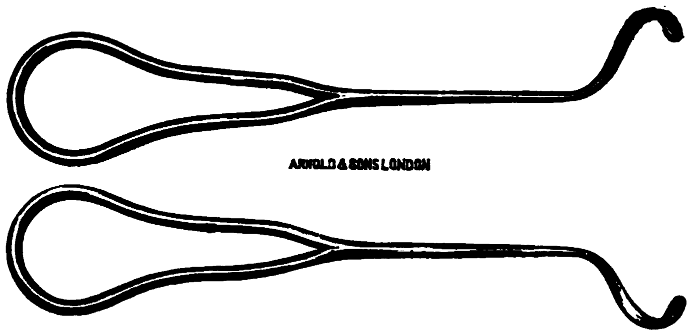


FIG. 62.
Curved hernia needles, MacEwen's, for suturing the inguinal ring.

incision made into the scrotum ; the spermatic cord is ligatured as high up as possible and the testicle removed, the orifice of the inguinal canal being sutured.

If castration is not to be practised and the hernia keeps returning after being repeatedly reduced, the best method to adopt would be that practised by Gray in cases of prolapsed rectum, *i.e.*, to perform laparotomy, withdraw the herniated intestine and suture it to the abdominal wall, taking care to pass the stitches through the serous and muscular coats of the bowel.

Perineal Hernia occurs as a soft swelling at the side of the anus ; it is not common when compared with the umbilical or inguinal varieties. The herniated organs are usually omentum or bowel ; Müller states that the bladder may also be included. Two methods of operating may be adopted, viz. (1) to cut directly down on to the swelling, remove a certain part of omentum [1] (if this be present), return the bowel, and excise an elliptical piece of the pendulous skin before suturing the wound, in order to get greater contraction when cicatrisation takes place ; or (2) to follow Gray's method as already advocated in scrotal hernia, *i.e.*, to perform laparotomy and suture the prolapsed organs to the interior of the abdominal wall.

Femoral Hernia is of such extremely rare occurrence as to only merit a passing allusion to it. Although each of the other forms of hernia has been recognised and treated, no case of the femoral variety has been seen in the College Out-patients' Clinique during the past seven years. According to Müller it is occasionally seen after fractures of the pelvis, occurring as a soft painful swelling in the inner fascia of the thigh. The principles of operation are the same as with other herniæ, very great care being necessary on account of the close proximity and size of the blood-vessels in this region.

The sequelæ of the operative treatment of hernia are as a rule satisfactory, provided the displaced organs have not become strangu-

1 "Journal of Comparative Pathology and Therapeutics," Vol. XII., p. 260.

lated. The chief mishaps likely to occur afterwards are, (1) violent removal of the sutures by the patient, and subsequent descent of the bowel or other organ; (2) hæmorrhage either at the time of operating or afterwards. All arteries and veins should be ligatured during the progress of the operation. Two of our most promising patients (inguinal cases) slowly bled to death within three days after the operation, through injury to some veins at the time of operating. (3) Peritonitis, which can only be avoided by absolutely following out the principles and details of aseptic surgery.

These statements are based upon thirty-nine consecutive cases,[1] of which twenty-five were inguinal, nine umbilical, two abdominal, two scrotal, and one perineal.

Prolapse of the Rectum. Reduction.—Reduction of a prolapsed rectum should be effected by careful manipulation with the fingers, covered by a thin cloth soaked in cold antiseptic solution, care being taken to avoid injury from the nails; a blunt instrument (such as a metal thermometer case) manipulated up the lumen of the rectum is often of material help. When returned, sutures may be put across the anus, or, as recommended by Müller,[2] a tobacco pouch suture may be inserted. This consists of thin tape or fairly stout silk passed through the skin in and out completely around the exterior of the anus, the two ends being drawn together tolerably tight, like the strings of a purse or bag, and tied. Stockfleth[3] advises a similar procedure for constricting the rectum, by placing pins at intervals around the anus and uniting them with threads. Pessaries introduced into the rectum usually do more harm than good, and act as a continual source of irritation. Gray[4] and Liénaux[5] have successfully treated cases by laparotomy, the prolapsed bowel being withdrawn with the fingers and sutured to the abdominal wall, and care being taken only to pass through the serous and muscular coats of the bowel.

The chief trouble to be dealt with is the straining which often takes place afterwards, and causes a return of the prolapse. This is to be guarded against by keeping the animal as quiet as possible, resort being had to the medicinal use of morphia, given hypodermically or in the form of suppository, if necessary. After-treatment consists in careful attention to the diet, which should be sparing and of a kind likely to influence the consistency of the fæces and keep them soft and pultaceous.

When the rectum has been out for some days and adhesions have taken place it is often impossible to return it, and excision must be practised.

Excision.—This can be done under the influence either of a general or a local anæsthetic, the patient being placed on the operating table in the abdominal position. Antiseptic solutions are thoroughly applied to the exterior and interior of the rectum, and the protruding portion is allowed to rest on a thoroughly clean cloth soaked in antiseptic. A round metal sound or probe (an ordinary clinical thermometer case answers very well) is inserted into the lumen of the rectum, and four or five catgut interrupted sutures are

1 "Veterinarian," March 1896; "Journal of Comparative Pathology and Therapeutics," Vol. VIII., p. 151, Vol. X., p. 170; "Veterinary Record," Vol. X. p. 282.
2 "Diseases of the Dog" (Glass's translation), p. 73. 3 Idem.
4 "Veterinary Journal," Vol. XL., p. 401. 5 "Veterinary Record," Vol. XI., p. 561.

passed through the bowel down on to this and back again, close to the sphincter of the anus, in order to prevent the intestine from disappearing completely into the abdomen when the everted portion is cut off. A circular incision is then made with a sharp scalpel below the sutured portion, and the prolapsed part removed. After-treatment consists in the application of antiseptics to the anus, the patient being kept on soft, sloppy diet in order to avoid constipation, and care taken that no violent exercise is indulged in for at least a week or ten days. The results are excellent if the animal is not too weak to stand the operation.[1] In one case which came under our notice a young bull-terrier had three separate portions excised by this method within a month, and ultimately made a good recovery. A stricture may sometimes follow, but as a general rule the case terminates satisfactorily.

Operation for Imperforate Anus.—This condition is one occasionally met with in the newly-born puppy or kitten, there being no visible anal opening. The operation for its relief is very easy if a rectum is present, consisting simply in making an incision through the skin covering the end of the intestine in the seat where the anus ought to be, cutting a portion out so as to separate the two edges of the wound, and keeping them from uniting by the application of nitrate of silver or some other caustic until defæcation has become fairly established. If the intestine is normal a satisfactory termination may be looked for.

Operation for Obstruction of the Anal Glands.—The anal glands frequently become filled with purulent and semi-solid material which cannot escape, and gives rise to symptoms of irritation and annoyance on the part of the animal.

Temporary relief can be afforded by the application of pressure, the contents being squeezed out, but as a rule they refill in a very short time.

In such cases the parts should be painted with solution of cocaine (four or five per cent.), the gland freely opened with a Symes' knife or fine scalpel, and the interior scraped with a small, sharp curette. The parts are then treated antiseptically like an ordinary wound.

Recovery is usually uninterrupted, although sometimes a little prolonged.

Anal Tumours are treated as already directed under the heading of tumours. Unfortunately they are often of a malignant nature.

Operation for Fistula of the Anus.—True fistula of the anus is comparatively rare in the dog; enlarged anal glands and other discharging sinuses in this region are not uncommonly confounded with it. Foreign bodies, such as needles and pieces of sharp bone, are the usual cause. Careful examination should always be made by passing a blunt pointed probe up the suspected fistula, and at the same time feeling for the internal orifice with one finger in the rectum. The probe must be passed very carefully, and not in any way forced, as there may be several sinuses, some of them being blind ones. Treatment consists in opening up each sinus freely, carefully curetting the walls or treating them cautiously with some caustic to destroy their indurated lining, and afterwards applying antiseptics in the same way as to an open wound. In cases where

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 174; "Veterinary Record," Vol. X., p. 213.

ulceration of the bowel has not taken place the wound generally heals up and brings about a satisfactory termination, although progress may be slow.

Operation for Hæmorrhoids.—A dilated and very troublesome knotty condition of the veins around and just within the anus is not infrequent in fat old dogs, especially pugs, and gives rise to a good deal of pain and irritation, especially when fæces are passed, and when the animal is at all constipated.

The enlarged veins should be picked up with forceps, and either ligatured, by passing a curved needle and silk around them, the intervening portion being excised, or clamped and removed with the actual cautery.

Operations on the Urinary Organs.

Examination of the Prepuce or Vagina, and Removal of Foreign Bodies.—The interior of the prepuce or vagina can be examined for some distance from its orifice by the aid of the fingers or by the insertion of a speculum of similar design to that already described for the ear. The female can be examined in the standing posture, unless very restless, in which case the dorsal position on the operating table with the hind legs raised and held over the body will be found to be the most convenient, whilst in the case of the male the animal should be held or fixed on its back with the hind legs spread well apart.

Foreign bodies, other than tumours, are removed by the aid of forceps. Tumours are often a source of great trouble, and some varieties re-occur very rapidly.

In the prepuce of the dog and the vagina of the bitch one frequently meets with a species of ulcerating papilloma which is communicable when the animals are used for stud purposes.[1] If left, these tumours grow very large, causing an offensive, fœtid, and continuous discharge. To effect their removal, the knife and curette must be used freely, the parts having been anæsthetised by cocaine solution or the animal placed under chloroform. The return of the growth is usually rapid, and the animal is valueless for breeding purposes; as a rule a dog will not copulate with a bitch suffering from these tumours. Their vascularity is much increased at time of œstrum.

In the bitch their growth can be very much retarded if oöphorectomy is performed in addition to the curetting[2]; these operations, however, should be done on separate occasions.

As a sequel to the curetting, death has been known to ensue from inflammation of the bladder, owing to the retention of urine consequent upon a swollen condition of the mucous membrane of the vagina around the urethral orifice.

Passing the Catheter.—In the smaller varieties this operation is one of extreme difficulty, and in many cases quite impossible on account of the small size of the urethral canal. In cats and small dogs a bougie can often be passed, and will frequently answer the same purpose. Both catheters and bougies are made in sizes known according to the diameter as No. ½ to 12. For canine and feline work Nos. ½ to 5 answer in the majority of cases.

[1] Smith and Washbourn, "Journal of Comparative Pathology and Therapeutics," Vol. XI., p. 41.
[2] "Veterinary Record," Vol. X., p. 30.

In the female of the larger breeds, the instrument can be passed whilst the animal is standing, but in smaller ones it is often of advantage to place the patient in the dorsal position and introduce a speculum as an aid to finding the urethral entrance. The catheter, which in the female may be of elastic gum or metal, is guided gently by the forefinger into the orifice of the urethra, this being found as a small opening on the floor of the vagina, and carefully introduced in a slightly downward and backward direction into the bladder.

To pass the catheter in the male, the animal should be placed on its back or side, the operator having both hands free to manipulate the instrument and penis. The penis is forced gently but firmly out of the prepuce, the latter being pushed back at the same time and the catheter carefully introduced into the urethra. Gentle pressure is then exerted, and the catheter slowly passed into the bladder. Sometimes resistance is met with when the instrument reaches the perineal arch, but this can be readily overcome by withdrawing the stylet for a short distance, and thus allowing the more flexible canula to go forward by itself.

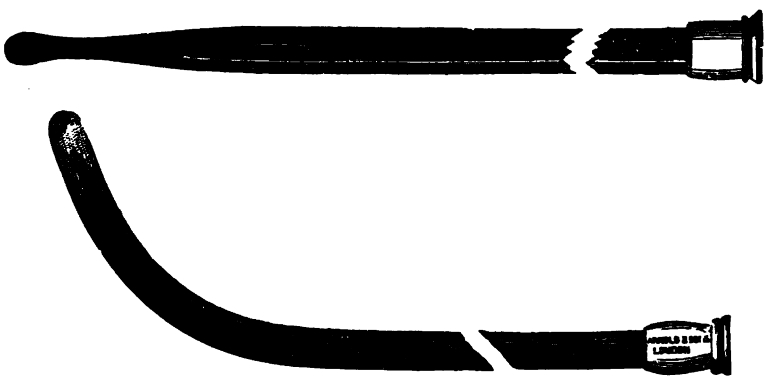


FIG. 63.
Catheters.

Having thus introduced the catheter into the bladder, the only remaining procedure is to carefully withdraw the stylet and allow the urine to come away.

Attention must always be paid to the cleanliness of the catheter, and, before being introduced, the instrument should be lubricated with some antiseptic, such as pure vaseline, boracic acid ointment, or oil containing some antiseptic.

Operation for Imperforate Urethra.—Imperforate urethra is occasionally met with ; if the stoppage occurs at its extremity, an incision with a scalpel will give immediate relief. Precautions must be taken to prevent union of the edges of the wound, either by making a fairly large orifice, or by the application of the cautery.[1]

Removal of Calculi from the Urethra ; Urethrotomy.—In the dog and cat, particularly in male animals, small calculi are occasionally met with in the urethral canal. They cause acute pain during their passage through the urethra, and frequently give rise to

[1] "Journal of Comparative Pathology and Therapeutics," Vol. IX., p. 155.

cystitis and even rupture of the bladder. They can readily be diagnosed when an attempt is made to pass the catheter, as they form an obstruction which prevents the instrument from going beyond a certain point. In the majority of cases the calculi become lodged in that portion of the canal which runs through the *os penis* or immediately behind that bone. Sometimes the catheter can be so manipulated as to dislodge the stone, when, if it is not of too large a size, it may be washed out of the urethra with the next outflow of urine. In large dogs a pair of long thin urethral forceps can be

FIG. 64.
Urethral forceps.

passed up the urethra and the stone removed, but this is rendered exceptionally difficult in small patients on account of the narrowness of the groove in the bone of the penis. Failing these, the operation of urethrotomy must be performed.

For this operation in the male the dorsal position is the best, but struggling must be avoided as much as possible on account of the risk of rupturing the bladder; this latter accident is indicated by the sudden collapse of the patient. A local or general anæsthetic is made use of, the parts are thoroughly cleaned with some antiseptic, and a catheter is passed up the urethra as far as the obstruction. An incision is made in the median line directly over the calculus, which is then removed together with any others within reach, and the parts are thoroughly washed with a fluid antiseptic. Sutures may or may not be applied, according to the size of the wound and the discretion of the operator. We have been in the habit of using them, suturing the muscles and skin separately without touching the mucous membrane of the urethra; Müller[1] recommends that the wound be left open. The catheter should be passed right into the bladder to make sure that the passage is clear, as the presence of a small stone in the urethra usually indicates that there are others higher up; on two occasions we have counted more than fifty small calculi in urethra and bladder. In some cases it is a wise plan to leave the canula of the catheter *in situ* for some hours after the operation. The wound itself is treated with antiseptics in the usual manner.

The prognosis of these cases must always be guarded, especially where the patient has been left until almost in a state of collapse before surgical aid is attempted.

In the female the shorter urethral canal does not offer quite so many difficulties. A calculus lodged in it can sometimes be grasped and crushed or withdrawn by a pair of fine forceps, or if necessary a fine blunt pointed tenotome or Paget knife may be used to enlarge the orifice. Material assistance in removing calculi from the urethra of the bitch can often be obtained by manipulation with the finger through the rectum.

[1] "Diseases of the Dog" (Glass's translation), p. 179.

Operations for Renal Calculus, Nephro-Lithotomy, Nephrectomy.— Although calculi of the kidney are by no means common, they are not infrequently met with by those who have a large number of canine patients to deal with. As a general rule, they are not diagnosed until the *post-mortem* examination is made, and it is the difficulty of making a certain diagnosis which is at present so hard to overcome.

By the term "nephro-lithotomy" is indicated the operation of cutting into the kidney in order to remove a stone. A laparotomy is performed in the usual way in the flank on the side suspected to be affected, and the kidney is exposed to view. As a rule, the calculus is situated in the pelvis. An incision is made directly down on to it, it is removed, and the wound is drawn together with fine catgut sutures. The peritoneal wound is treated in the usual way.

Nephrectomy (removal of the kidney) has been performed many times experimentally on healthy animals, and in human surgery it has taken its place amongst the useful operations. In canine practice, in addition to the difficulty of diagnosing tumour, calculus, or other disease of the kidney necessitating its removal, we have the fact that (in the case of calculus at all events), as a rule, when one kidney is affected the other has also become affected before professional aid has been sought.

In thin animals the kidney can be removed by an incision made in the median line, and this gives a little advantage when uncertainty exists as to which is the diseased side. In larger patients an incision is made in the lumbar region. The operation is not difficult; the kidney is carefully separated from its situation under the loins, two silk ligatures are passed around its pedicle, and an incision is made between them. The peritoneal wound is sutured and treated in the usual way.

Puncture of the Bladder.—This operation is most commonly done in cats, and the smaller varieties of dogs in which it is impossible to pass the catheter. It is performed in order to evacuate the contents of the bladder when this organ is over-distended.

The most convenient situation for operating is a spot in the linea alba from about 1 to 3 inches (depending chiefly upon the size of the patient) behind the brim of the pelvis, the object being to pierce the bladder in a part where it is tense and yet fairly close to the neck. The patient is very gently placed on the back or side, the bladder being grasped carefully but firmly through the walls of the abdomen with one hand and held as near the seat of operation as possible. Having carefully applied antiseptics, a trocar and canula (which should be of a fine bore) are inserted subcutaneously for a short distance and then directly into the bladder. The trocar is withdrawn and the urine allowed to escape. After-treatment consists in withdrawing the canula carefully, drying the surface of the wound and covering it with iodoform or orthoform and collodion.

It is risky to administer a general anæsthetic in the majority of these cases, or even to fix the patient firmly, as if the bladder is much distended rupture or sudden collapse is apt to occur; two such cases have occurred in the College Out-patients' Clinique during the past two years. As regards sequelæ, in so far as the operation itself is concerned, if antiseptic precautions are observed no evil results need be feared; it can be depended upon to give great relief, and, if the patient is not too

much exhausted, or the cause of the distension is not some permanent obstruction in the urethra or neck of the bladder, the benefit is usually immediate and permanent.

Lithotomy and Lithotrity. — Both these terms are applied to the operation whereby calculi are removed from the bladder, the first term being used when the bladder is incised and the stone or stones extracted, and the latter when the calculi are first crushed or broken up into fragments sufficiently small to be removed through the urethra.

Lithotomy is performed as follows. After the bladder has been emptied with a catheter, and carefully washed out with solution of chinosol, boric acid, or some other antiseptic, the patient is anæsthetised and placed in the dorsal position, laparotomy being performed as already described. The site of operation in the male is either on the median line immediately in front of the penis, or else in the flank a little to the right or left of that organ, and in the female on the median line immediately in front of the edge of the pelvis. The bladder is carefully raised and drawn into the wound, where it is packed round with antiseptic lint; a longitudinal incision is made down its centre in the least vascular portion, as near as possible directly over the stone. This is carefully removed with forceps, after having been first broken up with a lithotrite, if at all a large one. If, as is not uncommon, it is adherent to the interior, care must be taken to loosen it very gently from its attachments. If a number of small stones are present they must be removed with a blunt scoop or forceps. The interior is then carefully washed with some trustworthy non-irritant antiseptic, and the edges drawn together with sutures. In four cases in which we have sewn up wounds of the bladder Lembert's sutures of silkworm gut were used, but catgut or silk has been used, and some operators suture through the whole of the coats at once in the ordinary way with interrupted sutures. As a rule, the wound in the bladder heals very satisfactorily if antiseptic precautions have been rigidly carried out. Sewell[1] records two cases in which calculi were removed in this way, in one of which the stone weighed over 3 oz., the patient herself only weighing 14 lbs.

In lithotrity the abdomen is not opened, the stone or stones being reached through the urethra. In the male, after anæsthesia has been established, the animal is fixed on the operating table in the position illustrated in the photograph, the hind legs being drawn forward so as to efficiently expose the seat of operation, which has already been shaved and rendered thoroughly aseptic. The urine having been previously drawn away, and the catheter left in position in order to clearly define the outline of the urethra, an incision is made directly on to this in the perineal region, about midway between the testes and the anus. An aperture of sufficient size to introduce the lithotrite is made in the urethra, and the catheter steadily withdrawn. The curved end of the lithotrite is introduced, passed round the pelvic border, and into the bladder. Search is made for the calculus, which must be manipulated until it is firmly fixed between the jaws of the instrument, when steady pressure is exerted upon it, in order to

1 "Veterinary Record," Vol. XI., p. 509.

break it up into small pieces, care being taken not to include the mucous membrane of the bladder. Some of the larger pieces may require a second application. The fragments are then got rid of, either by forceps or by continual irrigation with an antiseptic fluid, such as solution of chinosol. The wound is then sutured, the

Fig. 65.
Photograph of dog secured for posterior pubic lithotrity.

urethra itself with fine silk, and the muscles and skin separately, the whole being covered with iodoform or orthoform and collodion. In small patients it is sometimes impossible to suture the urethra, and even in the larger ones some operators prefer to merely suture the

Fig. 66.
Lithotrite.

skin and muscles. Where the animal is of a quiet disposition a catheter may be left in the urethra for two or three days with advantage, but if it gives rise to irritation and consequent continual efforts to lick the parts its continued use is best avoided.

After-treatment must depend a little upon the progress made; diet should be of an easily digestible character and sparing in quantity, the supply of fluids being limited for the first three or four days.

If a little urine finds its way through the wound extra care must be taken as regards cleanliness, but no alarm need be felt so long as the lower part of the urethra remains open. If much pain is shown morphia should be given hypodermically, or some sedative to the mucous membrane of the bladder (such as hyoscyamus) administered by the mouth.

In the bitch the vaginal method recently described by Sewell[1] is one which has given excellent results in cases where the patient is of sufficient size to allow it to be done. The method of fixing is the same as already described for urethral lithotrity in the male.

[1] "Veterinary Record," Vol. XI., page 510.

A conical shaped dilating speculum (Avery's or Kramer's answer well, *see* Figs. 39 and 40) is forced into the vagina to dilate the passage as much as possible, then withdrawn, and a urethral dilator pressed into the urethra until the latter is sufficiently large to admit the little finger. This is then withdrawn, replaced by a small pair of stone crushing forceps or a lithotrite, which is passed directly on to the stone in the bladder. Care is taken to make sure that the mucous membrane of the bladder is not included, and the stone is broken up into small pieces. The pieces are then removed by means of Thompson's evacuator.

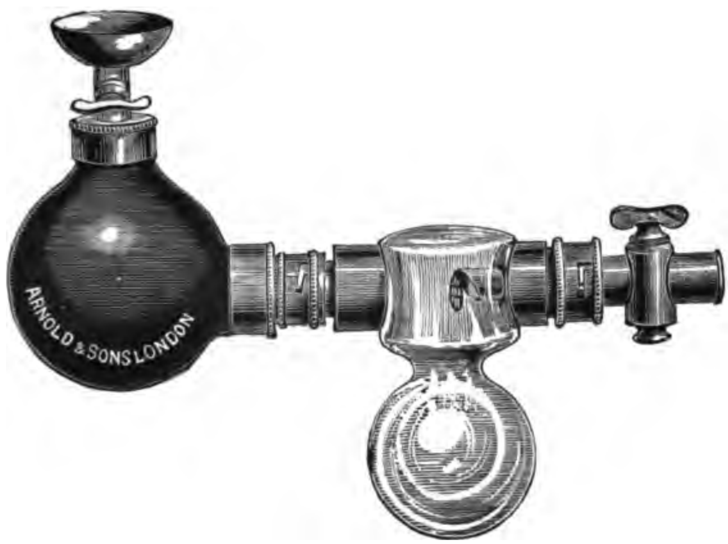


FIG. 67.
Thompson's evacuator.

Sewell records one case in which he was able to remove a stone about the size of a hazel nut from the bladder of a bitch without breaking it after enlarging the urethra with a small bistoury. Gray[1] has had a similar experience. The after-treatment is the same as already described for the dog.

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 87.

(*To be continued.*)

THE USE OF THE FLESH AND MILK OF TUBERCULOUS ANIMALS.[1]

By Dr OSTERTAG, Professor at the Veterinary College, Berlin.

AS Gerlach has said, in former times opinions regarding the use of the flesh of diseased animals varied like the fashions in dress, and this is specially true of the flesh of tuberculous animals. Opinions regarding the use of the milk of tuberculous cows are also very variable. An explanation of this is to be found in the fact that, until recently, there was no method of demonstrating conclusively the correctness or erroneousness of the views put forward with regard to the use of the flesh and milk of tuberculous animals. Quite a new turn was given to the matter when Robert Koch discovered the tubercle bacillus in 1882. The question of the use of the flesh and milk of tuberculous animals was thereby removed from the stage of theoretical speculation, and became the object of careful experimental examination.

When one takes into consideration the experimental investigations which have been carried out regarding the virulence of the flesh and milk of tuberculous animals, and also the reliable observations which have been made concerning the injurious character of the products of tuberculous animals, what has to be said regarding the use of such flesh and milk may be arranged as follows:—

I. THE FLESH OF TUBERCULOUS ANIMALS.

The transmissibility of tuberculosis to human beings by means of the flesh or organs of tuberculous animals must be considered to flow from the fact, first established by Koch, that the bacillus of tuberculosis of the lower animals is identical with that of human tuberculosis. The possibility of such transmission is also strengthened by the successful attempts to transmit the disease from animal to animal by feeding with tuberculous organs.

As an example of transmission in this way I may cite an experiment of my own in which the disease was transmitted to six young pigs by feeding them with portions of tuberculous lungs. Two young pigs of the same litter were kept as a control, and these were found to be healthy when submitted to *post-mortem* examination. Further evidence of the transmissibility of tuberculosis of the domestic animals, especially bovine tuberculosis, to the human subject is furnished by the cases recorded by Pfeiffer and Ollivier, in which the disease was communicated to human beings by animal products.

In Pfeiffer's case the veterinary surgeon Moser contracted tuberculosis through making a *post-mortem* examination of a tuberculous cow, and in the case reported by Ollivier five girls in a Parisian boarding-school became tuberculous through using the milk of a cow affected with tuberculosis of the udder.

It must thus be considered as firmly established that tuberculosis

[1] Translation of a paper contributed to the Seventh International Veterinary Congress.

can be transmitted to the human subject by the consumption of tuberculous organs.

The next and most important question to be asked is: What is the extent of this danger, and is it always in existence, or only in particular cases?

In order to answer this question, we must consider the etiology of tuberculosis of the domestic animals, and the result of the experiments conducted with the muscle juice of tuberculous cattle.

Tuberculosis may be brought about either in consequence of tubercle bacilli having been taken in with the inspired air (primary tuberculosis of the lungs), or through the ingestion of the bacilli with food (primary intestinal tuberculosis). These cases form the rule, and the few cases of intra-uterine and genital infection have but little interest on account of their rarity. Whatever be the way in which tubercle bacilli gain admission to the animal body, they first remain for a time in the organ into which they have penetrated, and do not pass beyond the corresponding lymphatic glands. The careful statistics which have been made in various slaughter-houses regarding the extent of the disease in slaughtered animals have shown that in the immense majority of cases of tuberculosis the disease may, during the life of the animal, remain confined to a single organ—the lungs, for example, in cattle.

It consequently appears that in the animals slaughtered for food purposes the lymphatic glands possess the power of preventing the access of tubercle bacilli to the large lymph stream, and hence also to the blood stream.

A completely generalised tuberculosis, in the sense of Weigert's definition, may be brought about in the lower animals, just as in the human subject, by the formation of tuberculous lesions in the wall of a vein or of the thoracic duct; such lesions, like tuberculous centres on mucous membranes, undergoing degeneration, and allowing the tubercle bacilli contained in the degenerated products to be carried directly or indirectly into the blood stream. Tubercle bacilli which have thus gained the blood current may set up tuberculous lesions in various parts of the body. It would, however, be an error to suppose that after an irruption of tubercle bacilli into the blood stream the generalised tuberculosis continues to exist in the sense that tubercle bacilli continue to circulate in the blood. This question has been settled by the valuable investigations of Nocard. This distinguished authority has shown that after the intravenous injection of tubercle bacilli the blood in four or five, or, at the most, six days loses its infective power through disappearance or excretion of the bacilli. An animal may thus show the anatomical signs of generalised tuberculosis without having tubercle bacilli in its blood, and therefore in the whole of its body. This fact has been corroborated by the writer's own experiments, in which he inoculated with muscle juice and particles of lymphatic glands taken from animals in which the disease had some time previously become generalised. The fact is one of the very greatest importance in the practice of meat inspection. It is worthy of remark that the generalisation of tuberculosis which in the slaughtered animal is manifested by the presence of more or less numerous specific tubercles or nodules in parts which can be infected only through the medium of the general circulation

need not interfere with the general condition of the animal, and that typical generalised tuberculosis is often met with in cattle and pigs in the very best of condition ; in pigs, indeed, this is the rule.

On the other hand, there is a second form of generalised tuberculosis in which the general condition of the animal is notably disturbed, and which, as we know, may of itself determine the death of the animal. This form is met with when tuberculous abscesses are present in the organs primarily attacked with the disease ; in the ox, for example, one meets with it in cases in which extensive areas of softening are formed in the lungs or in the mesenteric glands. In these cases of generalised tuberculosis one finds, in addition to the emaciation, embolic tubercles of different ages in organs (spleen and kidneys) which can only be infected by generalisation—a proof that in these cases the tubercle bacilli have been thrown into the blood stream not merely once, but frequently, possibly constantly. This is a condition similar to that which occurs in consumption of the human subject. Steinheil found that the muscle juice of persons who had died from phthisis was as a rule infective, and Kastner made a like observation regarding the muscle juice of cattle suffering from advanced tuberculosis, with lesions in almost all the organs, and softened tuberculous centres similar to those occurring in the human subject. In twelve tuberculous animals in which, as is the rule in cattle and pigs, the lesions had undergone dry caseation, Kastner found that the muscle juice was not virulent, even when he employed the extremely delicate test of intra-peritoneal inoculation of guinea-pigs.

In the softened tuberculous lesions the bacteria of suppuration as well as tubercle bacilli are to be found, and it is obvious that the power of the pyogenic bacteria to dissolve solid tissue must favour the irruption of tubercle bacilli and their metabolic products into the blood stream.

To Johne belongs the credit of having given us clearer notions with respect to the at one time much-discussed question of the danger of the flesh of tuberculous animals ; he says that flesh must first be regarded as infected, and therefore as infective, when the tuberculosis has become generalised. The principle herein enunciated marked a great improvement on the arbitrary rules which had previously been put forward for judging the flesh of tuberculous animals.

Johne's statement is subject to some limitation in consequence of Nocard's discovery, already mentioned, that after generalisation the flesh need not necessarily be regarded as infective.

In view of the considerations discussed above, there cannot be any doubt that the flesh of tuberculous animals ought to be regarded as infective, and therefore unfit for the food of man, in all cases "in which the disease has determined emaciation, and in those in which there is evidence of a recent blood infection (swelling of the spleen and of the whole of the lymphatic glands, with miliary tubercles in the lungs, liver, spleen, or kidneys)."

It is quite different with the flesh of animals "in which the anatomical characters of the lesions indicate generalisation but show that they owed their origin to an irruption of tubercle bacilli which took place some considerable time ago." In such cases it cannot be supposed that tubercle bacilli are still circulating in the blood.

While I was engaged as a slaughter-house inspector, the flesh of all

tuberculous cattle and pigs, in conformity with Johne's rule and the authoritative regulations then in force, were condemned, even when only a single tubercle could be discovered in the spleen or in one of the kidneys. As a rule these animals were in very good condition. After the animals had been confiscated I had the opportunity to thoroughly search their flesh for tuberculous lesions. I thus found that in the majority of the animals tuberculous lesions were absent from the muscular tissue and from the bones and lymphatic glands included within the muscles. These cases furnished me with the proof that generalisation of tuberculosis may occur without leaving a trace in the muscular system and in the other edible portions of the carcase, and that this is very frequently the case. Confiscation of such animals would, as a matter of fact, be justified only if the older view were correct, viz., that when tubercle bacilli have once been thrown into the blood stream they continue to circulate with the blood. This supposition, however, has been proved to be erroneous, and there is therefore no ground whatever for abstaining from the use of the flesh of animals in which the disease has become generalised a considerable time before they are killed.

There are cases, however, "in which generalisation of tuberculosis has led to specific disease of the muscular system, a bone, or an intra-muscular lymphatic gland, while the general mass of the muscles has remained free from tuberculous lesions." In these cases, on account of the disease of the muscular tissue, the whole carcase would be condemned. Hartenstein, however, has quite correctly pointed out that the whole of the carcase is not necessarily dangerous because tuberculous lesions are present in the muscles of one region of it, and that it is therefore scarcely justifiable to condemn the whole carcase because of the presence of tuberculous disease in a prescapular lymphatic gland. It is simply in conformity with the now generally sanctioned procedure in cases of generalisation of some standing when one, in a case in which only one tuberculous lesion is present in some region of the body, condemns only that particular region.

Experience has shown that tuberculous lesions are very rarely present in the muscular system or flesh proper. The intra-muscular lymphatic glands and the bones are more frequently attacked. While I was acting as a slaughter-house inspector, in numerous cases in which tuberculous disease was present in the edible part of the carcase I could discover only one bone and the corresponding lymphatic glands affected, and similar observations have been made elsewhere. There is therefore no reason whatever, when tuberculous disease is present in an intra-muscular lymphatic gland, why the muscular mass from which the efferent vessels of the gland proceed should not be passed for sale in the sterilised condition, provided the bones and the lymphatic vessels passing from them to the lymphatic gland have been first cut out, and provided that careful examination has shown that the muscular tissue itself is free from tuberculous lesions. Sterilisation of the flesh is necessary because, in spite of an examination of the cut surfaces, it cannot be positively asserted that the muscular tissue is free from tuberculous lesions.

In the same way, in the cases just referred to, the fat removed from around the tuberculous lesion may be melted down and made fit for

use, for the temperature necessary for melting it is more than sufficient to render innocuous any tubercle bacilli present in it.

The whole of the flesh must be sterilised before it is passed for sale in those cases in which the local character of the tuberculosis, and therefore the wholesomeness of the flesh, appear doubtful. Such doubts may occur when tuberculous caverns are present in the internal organs of an animal whose condition has begun to fall off, if embolic tubercles of various ages, indicating repeated irruptions of tubercle bacilli into the blood stream, are absent from the spleen and kidneys.

When there is no doubt whatever regarding the local nature of the tuberculosis there is no ground for condemning the flesh, for in local tuberculosis the flesh must be regarded as non-injurious. It is hardly necessary to prove this statement at length.

On the other hand, there remains to be considered the question whether in local tuberculosis the flesh ought not on other grounds to have certain limits placed to its free sale. The American writer Law has suggested that the flesh of tuberculous animals, even when it contains no tubercle bacilli, may act injuriously through the tuberculin contained in it. A. Eber, however, has shown that it is impossible to detect tuberculin even in large quantities of blood from highly tuberculous animals.

Nor is the nutritive value of the flesh of tuberculous animals less than that of the flesh of those that are non-tuberculous. Proof of this has been furnished by Rumpel, who fed a bitch with flesh from slightly tuberculous animals, and thereby found that there was no reason for regarding the flesh of tuberculous animals as being of less than the ordinary value. In the experiment it was found to be quite as nourishing as normal flesh.

With respect to the facility with which it can be absorbed, there was also found to be no difference between the flesh of tuberculous animals and normal flesh, and since, further, the flesh of animals suffering from local tuberculosis does not differ in appearance, colour, consistence, or keeping properties, from that of healthy animals, there exists no ground for placing any limitation on its sale. Lastly, it may be observed that the slighter degrees of tuberculosis are as a rule "unexpectedly" met with in animals which have during life exhibited the picture of undisturbed health.

The sale of the flesh with an intimation of its special character is only justified when the local tuberculous lesions are of great extent, as, for example, when the peritoneum and pleura are affected. In that case, even when the disease has not rendered the flesh dangerous to health, the meat must be considered decidedly defective from the point of view of meat inspection.

Such a method of dealing with the flesh of tuberculous animals would render it quite impossible for unwholesome meat to reach the market.

This danger is certainly not great. The inoculation and feeding experiments made with the flesh, muscle juice, and blood of tuberculous cattle by Nocard, Galtier, Forster, Bang, Bollinger and his pupil Hagemann, Kastner, Perroncito, and the writer, have shown that in cases of advanced tuberculosis the flesh sometimes contains tubercle bacilli, but that as a rule the number of bacilli present in the

muscular tissue is not large enough to set up tuberculosis when animals are experimentally fed with it. With regard to this point, the investigations of Nocard, Galtier, and Perroncito are very instructive. Nocard used the muscle juice from twenty-one cows affected with generalised tuberculosis to inoculate guinea-pigs intra-peritoneally. Only in a single case was one of the guinea-pigs (out of four used for the experiment) thereby infected with tuberculosis. All the feeding experiments made with the flesh of tuberculous cows had negative results. Even the flesh of the cow which induced inoculation tuberculosis in one of the guinea-pigs had no injurious effect on four cats, although they ate more than 500 grammes of it. In his inoculation experiments with muscle juice from fifteen tuberculous cows Galtier on two occasions produced tuberculosis, but he also in no single case was successful in infecting cats, dogs, calves, or pigs, by feeding, although the animals were given as much flesh as they would eat. Perroncito injected more than 200 rabbits and as many guinea-pigs subcutaneously and intra-peritoneally with the muscle juice of tuberculous animals without obtaining one positive result. Furthermore, four young pigs which were fed continuously for four months, and twelve which were fed continuously for five months, with the flesh of tuberculous cattle remained quite healthy.

The case is different when organs have tuberculous lesions scattered through them; these must in every case be regarded as involving danger to human health. One of the most important objects of meat inspection with regard to tuberculosis is to see to the destruction of every organ affected with the disease. Hartenstein has remarked upon the astonishing fact that many professional inspectors who are most stringent with regard to the flesh of tuberculous animals allow tuberculous organs to be passed for sale. Such an occurrence ought to be prevented by making it the duty of every inspector to follow in the examination of slaughtered animals a definite method which will lead to the detection of even the slightest cases of tuberculosis.

The essential point in such a method of examination is to make it an invariable practice to cut into definite groups of lymphatic glands at the ports of entrance of the tuberculous virus. The correct execution of this method of examination can be easily supervised. Furthermore, in order to prevent arbitrary methods of dealing with tuberculous organs it ought to be authoritatively laid down that all tuberculous organs and the parts annexed to them, especially the corresponding lymphatic glands, are to be destroyed.

II. THE USE OF THE MILK OF TUBERCULOUS ANIMALS.

Veterinary and medical literature contains numerous observations proving beyond any doubt that tuberculosis can be transmitted to animals (calves and pigs), and to the human subject, by means of milk. The endemic of tuberculosis in the girls' boarding-school in Paris, recorded by Ollivier and already referred to, shows how fatal may be the effects of the milk of tuberculous cows in certain circumstances.

The facts relating to milk are somewhat similar to those relating to the flesh of tuberculous animals. Even the milk is not virulent in every case of tuberculosis. The experiments which have been

carried out in regard to this point have shown that only the milk of emaciated tuberculous cows, in which, as we have seen, the bacilli frequently gain access to the blood, and therewith also to the udder, and that of cows affected with tuberculosis of the udder, contains tubercle bacilli.

Bollinger was the first to call attention to the richness in bacilli and the great virulence of milk furnished by tuberculous udders. Subsequently, May tested the milk of five clinically tuberculous cows with sound udders, and obtained only negative results from his inoculations. Bang carried out feeding experiments on five young pigs and three rabbits with milk from tuberculous udders, and in the whole eight animals he produced tuberculosis. In later experiments he inoculated forty-eight rabbits with milk from twenty-eight clinically tuberculous cows with sound udders, and in only two cases was the inoculation followed by positive results, although almost all the cows were at an advanced state of tuberculosis.

Other experiments of Bang's were made with the milk of twenty-one cows which were also all highly tuberculous. The milk of seventeen of these cows was found to be non-infective, whereas that of the remaining four cows produced tuberculosis on inoculation. In three of these cases careful examination revealed tuberculosis of the udder, and the fourth case was that of a cow which had died from extensive tuberculosis.

Bang also inoculated rabbits and guinea-pigs with the milk from eight women suffering from advanced phthisis, and found that in no case was it infective.

Lucas succeeded in infecting four young pigs with tuberculosis, by feeding them with the milk of a cow suffering from tuberculosis of the udder.

Nocard tested the milk of eleven tuberculous cows, and found only one sample infective. This sample came from a cow suffering from mammary tuberculosis.

Schmidt-Mülheim inoculated guinea-pigs with milk from more than fifty cows free from tuberculosis of the udder, and obtained only negative results, although he had injected 50 ccm. of milk to each animal, and many of the cows were old and unsound.

Fiorentini has reported regarding the examination of the udder of seventeen highly tuberculous cows. The udder was sound in twelve of the cases, and in the other five it was affected with tuberculosis. In the twelve sound udders tubercle bacilli could not be detected either by histological or bacteriological examination, or by inoculation. Fiorentini sums up the results of his experiments by saying that: "Contrary to the view still held by some authors, tubercle bacilli do not pass into the milk until the udder is attacked with the disease."

As the result of their experiments with the milk of tuberculous cows, Smith and Schröeder arrived at the opinion that, "the milk of such cows as are affected with tuberculosis of the udder, or are emaciated, should be excluded from consumption."

Hirschberger, by inoculating with the milk of tuberculous cows, obtained results different from those of the above-mentioned authors. He inoculated guinea-pigs subcutaneously and intra-peritoneally with the milk of twenty cows found to be tuberculous on slaughter, and

obtained a positive result with the milk of eleven cows, including some which were affected only with local tuberculosis and were still in good condition. However, Hirschberger's experiments are in such sharp contradiction with those of other authors that one must assume that there was some source of error in them. In taking milk from the udders of slaughtered tuberculous cows it must be remembered that when the animal falls the teats come into contact with the floor of the slaughter-house, which is very frequently soiled with tuberculous materials, and also that in removing the skin tuberculous matter may easily be transferred to the teats by the butcher's knife, when that has previously been used for cutting into tuberculous lesions.

That the presence of tubercle bacilli in the milk is, as a rule, ascribable to the presence in the herd of one or more cows affected with tuberculosis of the udder, or clinically tuberculous, is also shown by the admirable investigations of Friis. He inoculated eighty-four rabbits and four guinea-pigs with samples of milk taken from forty-four of the Copenhagen dairies, these having from ten to eighty cows each. Of the inoculated animals thirty-seven rabbits and the whole of the guinea-pigs died immediately after the inoculation, so that, putting aside these eighteen samples, there remained only twenty-eight experiments in the series. Four had a positive result. When the herds from which these four virulent samples had been obtained were submitted to veterinary inspection, it was found that two of the samples came from herds containing cows affected with tuberculosis of the udder, and the two others from herds in each of which there was a cow strongly suspected of tuberculosis on account of cough and emaciation.

Through the experiments of Bollinger, Bang, Lucas, Nocard, Schmidt-Mulheim, Fiorentini, Smith, Schröeder, and Friis, it is proved that the chief danger with regard to the spread of tuberculosis lies in the milk of cows affected with tuberculosis of the udder, and that the milk of clinically tuberculous cows, and of those that are emaciated, ought also to be regarded as dangerous.

This conclusion is supported by the result of certain experiments which were carried out by me in the Hygienic Institute of the Berlin Veterinary College, at the instigation of the Prussian Minister for Agriculture. The experiments bore upon the question whether the milk of cows which have simply reacted to tuberculin, but which show no clinical symptoms of tuberculosis, contains any tubercle bacilli, or contains them in such numbers that tuberculosis might be set up by the use of the milk.

The materials used in the experiments, which were begun on 26th March 1898, and concluded during the last winter session, came from a farm near Berlin on which Bang's method of combating tuberculosis was being carried out. In testing the milk of the cows which had simply reacted to tuberculin, the milk of each separate animal, and afterwards samples of the mixed milk for a period of four weeks, were tested as to their tuberculous virulence.

Separate samples from fifty reacting milch cows were available for testing, and the samples of mixed milk which were used in the second series of experiments also came on an average from fifty cows. The quantity of milk submitted to the test in each case

was one litre. Of this quantity 80 ccm. was centrifugalised, and of each sample thus treated the cream and precipitate, made up with skimmed milk to 40 ccm., were injected into the peritoneum of four or three guinea-pigs. The remainder of each sample was used with the necessary precautions for the feeding of four or three guinea-pigs. The animals readily took the milk in quantities of from 200 to 300 gr., and consumed the whole of this in two or three days. Lastly, the remnant of the centrifugalised milk was microscopically examined for tubercle bacilli.

In the first series of experiments the results were negative. The milk of one cow killed within a few days the guinea-pigs which were inoculated intra-peritoneally with it, the same result being obtained when the experiment was repeated. So far as related to the animals experimentally inoculated, this cow had therefore to be put aside. The milk of this same cow, however, yielded negative results in the feeding experiments with guinea-pigs. In the case of all the other samples both the fed and the inoculated guinea-pigs, with one exception, were found to be free from tuberculous lesions when they were killed. The exceptional animal, as shown by the character of the lesions found in it, must have been infected with tuberculosis before it was submitted to experiment. In no single case could tubercle bacilli be detected in cover-glass preparations made from the milk.

In the second series of experiments made after the 24th October 1898, fourteen samples of mixed milk from the reacting division of the herd were taken, at intervals of from two to four days, and tested like the samples in the first series. Of the guinea-pigs inoculated in the second series one was found to be affected with slight abdominal tuberculosis when it was killed seventy-one days after inoculation. A second guinea-pig inoculated with the same sample of milk showed no trace of tuberculosis when it was killed, also after seventy-one days. Furthermore, 920 ccm. were consumed by three guinea-pigs. Of these one died on the second day, and another after fifty-two days. The third and both the inoculated animals were killed seventy-one days after the beginning of the experiment, and in none of them did a careful examination show any tuberculous lesion. Inasmuch as all the other inoculated and fed guinea-pigs of the second series of experiments were found to be quite free from tuberculosis when submitted to *post-mortem* examination, the experiments of the second series justify the conclusion that the milk of cows that have simply reacted to tuberculin may occasionally contain tubercle bacilli, without necessarily acting injuriously when it is used for feeding. Finally, it ought to be observed that, in the second series of experiments also, tubercle bacilli could never be found in cover-glass preparations from the precipitate of the centrifugalised milk.

The fact that in the second series of experiments there was one sample which, judging from the result of the *post-mortem* examination of one of the inoculated animals, contained tubercle bacilli, is to be explained by the circumstance already mentioned, viz., that even in latent tuberculosis tubercle bacilli may occasionally break into the blood stream and thus be excreted with the milk. Seeing, however, that tubercle bacilli soon disappear from the blood, such an occurrence does not involve any great danger of tuberculosis being transmitted

through the milk, for, as has already been shown, and as was proved by the feeding experiments carried out by me at the same time as the injection experiments, a single dose of milk containing tubercle bacilli does not produce tuberculosis when it is taken in by the mouth. It may therefore be concluded that the milk of cows which simply react to tuberculin, and which show no clinical symptoms of tuberculosis, is not dangerous.

The contrary is the case with the milk of cows suffering from tuberculosis of the udder, and with milk furnished by emaciated tuberculous animals, but especially the former. In no tuberculous products obtained from cattle are tubercle bacilli always so numerously present as in the secretion from a tuberculous udder. In respect of its richness in bacilli this secretion approaches human sputum, regarding which Bollinger has observed that its virulence on inoculation into the peritoneal is not abolished even when it is diluted to the extent of 1 : 100,000. To this it may be added that in tuberculosis of the udder tubercle bacilli do not merely pass into the milk occasionally, as in the case of a tuberculosis confined to the internal organs, but that the bacilli are constantly excreted with the milk, and in numbers which steadily increase with the spread of the disease in the gland.

The fact that milk from a tuberculous udder is always rich in bacilli —even at the outset, when the milk may appear perfectly normal— explains the contradictory results of the numerous experiments which have recently been made regarding the occurrence of tubercle bacilli in butter.

Obermüller, on the ground of his investigations, has asserted that the milk and milk products from creamery companies are more dangerous than the same obtained from private sources. But before this had been pointed out by Obermüller veterinary surgeons were acquainted with the dangerous character of the milk and the milk residues which are returned by the creamery companies for feeding pigs and calves.

The dangerous character of milk and milk products from public companies is determined by tuberculosis of the udder. From 2 to 4 per cent. of all tuberculous cows are affected with udder tuberculosis. Hence it happens that in small holdings, where the milk is furnished only by a few cows, the possibility that none of it comes from a cow affected with tuberculosis of the udder is much greater than in the case of a business in which the milk from several hundred or even thousands of cows is daily used in the mixed condition. In the large companies, owing to the frequency of tuberculosis of the udder, there must always be found some milk coming from cows so affected. It is therefore quite possible, as the investigations of Lydia Rabinowitsch have shown, that in the case of public companies the milk and milk products regularly contain tubercle bacilli, whereas that obtained from small concerns is in most cases free from them.

The most important measure for preventing the transmission of tuberculosis by means of the milk of tuberculous cows, goats, etc. must therefore consist in weeding out milking animals that are affected with tuberculosis of the udder, and those which are emaciated and tuberculous. This end can be attained by insisting that all milch animals, before they are used for that purpose, and regularly afterwards once a fortnight, shall be submitted to veterinary inspection.

The Copenhagen Milk Supply Association has for a number of years carried on the struggle against the transmission of tuberculosis through the milk of tuberculous cows, by insisting that the whole of the cows supplying milk to the company shall be examined twice a month by veterinary surgeons, and that every cow in which tuberculosis of the udder is thus detected shall be immediately killed.

Formerly the weeding out of cows affected with tuberculosis of the udder was attended with difficulty owing to the fact that the clinical symptoms of the disease were not sufficiently well known. To-day the symptomatology of tuberculosis of the udder is more accurately studied. Furthermore, in the bacteriological examination of milk, and in the method of harpooning the udder recommended by Nocard, we possess two very valuable aids in arriving at a certain diagnosis of udder tuberculosis.

On these grounds the prospect of the State being able to grapple successfully with tuberculosis of the udder, as is already done in Sweden and Denmark, is now much greater than it used to be. In Sweden and Denmark the veterinary surgeons are directed in all cases of suspected udder tuberculosis to send samples of the milk or particles of tissue obtained by harpooning the udder to the Bacteriological Institute of the national Veterinary College. When such examination confirms the suspicion the animal must be immediately slaughtered, the State compensating the owner. It is reasonable to expect that an order such as this will suffice to stop the most important source of tuberculous infection by means of milk.

THE NATIONAL VETERINARY ASSOCIATION AND TUBERCULOSIS. A PERSONAL EXPLANATION.

By J. M'FADYEAN, Royal Veterinary College, London.

AT the recent meeting of the National Veterinary Association I had the honour of opening a discussion on the prevention of tuberculosis in cattle, and a verbatim report of what I said on that occasion, copied from the recently published official proceedings of the Association, is printed at a later part of this number of the Journal. It has been thought advisable to thus afford readers of the Journal an opportunity of observing for themselves the extent to which what was said by me on the occasion in question was misrepresented by subsequent speakers in the debate, and by criticisms which have appeared in the columns of a number of journals, both lay and professional.

The offences in this direction have been of two different kinds. The first of these is illustrated by Professor Williams' charge that I appeared before the National Veterinary Association "as the special pleader for a cowardly Government." In slightly different words this insulting accusation was repeated by Mr Fraser, who said that I seemed to have used my abilities "to minimise the importance of tuberculosis to agriculturists and to consumers of meat." These expressions are, of course, capable of only one interpretation, namely, that I had deliberately represented the facts to be other than I knew or believed them to be. I venture to think that the readers of this Journal will not expect me to reply to this odious charge. To Professor Williams I will only say that, while I have on

many occasions during the last twenty years had to point out to him that he was wrong in what he supposed to be facts relating to matters of veterinary pathology, I have never so far forgotten the rules of polite discussion as to charge him with conscious misrepresentation; and regarding Mr Fraser's lapse from good manners it need only be remarked that those who put him in the position of honour which he temporarily fills probably expected better things of him. Accusations of *mala fides* against those who do not happen to share our opinions cannot possibly advance our knowledge regarding disputable matters, and they inevitably tend to lower the tone of debate.

The other offences against which a protest is necessary took the form of misquotations and misconstructions of what I said on the occasion in question. Here again Professor Williams was a leading offender. For example, he charged me with having said that "cattle owners suffer no loss from tuberculosis," and emphasised the charge by repetition, whereas the actual words used were that "the losses of farmers—the actual money losses of farmers—are seldom serious except when there has been some gross neglect of such simple precautions as the removal of animals that are obviously ill and dying from the disease," and farther on, "At the present time almost the only losses experienced by cattle owners through tuberculosis are those which result from keeping on, long after they ought to be killed or otherwise disposed of, animals obviously affected with tuberculosis." Comment upon the seriousness of this misquotation would be superfluous.

As another example, let us take the following from Mr Hunting's contribution to the debate:—"Professor M'Fadyean did not tell us, but he rather seemed to imply that it was a harmless or mild disease, which prevailed a little among cattle and a little among men, but it was not a bad sort of a plague, and if it did kill a few people it did not kill many animals." A grosser perversion of anything that I have ever said on the subject of tuberculosis than this it would be difficult to imagine. In almost the only reference which I made to the precise degree of prevalence of the disease among cattle, I represented it as a common experience to find 20 or 30 per cent. of the animals affected. No estimate was made of the number of human beings affected, but I have elsewhere suggested that the disease is probably just as prevalent in the human as in the bovine species. It is true that I expressed the opinion that only a small minority of the cattle that become affected with tuberculosis die from it, and Mr Hunting reproached me for not having told the meeting why this is so, and volunteered to supply the omission. He said that tuberculous animals inevitably would die from the disease if the owners did not sell them. That appears to me to be an assertion violently opposed to experience, for it is already a matter of popular knowledge that the great majority of animals in which the disease is detected by the tuberculin test may be kept to a good old age without exhibiting any symptom of disease, and without revealing more than insignificant lesions when they are killed. I did not explain why this is so, for the simple reason that I do not know why Providence should have decreed that certain diseases should not be very fatal for particular species.

In the entirely irregular debate which was allowed to take place on the second day of the Meeting, Mr Fraser made a speech in which

he disassociated himself from the views to which I had given expression on the previous day. Of that I make no complaint, for it is in the nature of things that we should not all agree on every subject, and I share the feeling of absolute disinterest with which I fear the public regard Mr Fraser's views on professional subjects. I do, however, complain that in my absence from the Meeting, after the discussion on tuberculosis had been closed, he was allowed to make it appear that I had denied that tuberculosis is caused by the tubercle bacillus, and that milk containing such bacilli is a dangerous article of food. Here are the words which he used, taken again from the Official Report of the proceedings: "Now if the speech of yesterday (the writer's) was confined to the Association, I do not think that we should need to trouble ourselves, because the impression made would have been very slight, but owing to the position which this gentleman occupies it would be wrong of us to allow him to use the influence which we possess in a direction in which we are not in sympathy. . . . We all know perfectly well, as well as we know the alphabet, that tuberculosis is due to the existence in the system of bacilli, which cause the development of the disease. We also know perfectly well that these bacilli are detected in the milk produced by the cow. Is that a fact or not? It is an acknowledged fact by every practised veterinary surgeon. Now, I ask you this question, gentlemen, is the consumption of milk which contains the bacilli of tuberculosis safe or not?"

I will leave it to those who read this article to say whether these quotations constitute honest and fair criticism of the speech to which they refer. I will, however, remark that it is a pity that Mr Fraser when he supposed himself to be in possession of the public ear, did not contrive to be a little more accurate in defining the danger to which the public are exposed through bovine tuberculosis. He says that it is acknowledged by every practised veterinary surgeon that tubercle bacilli are detected in the milk produced by the cow, and that "the meat of animals that have suffered from tuberculosis is also dangerous." I believe that in this matter Mr Fraser is behind the times. The statements are typical of the exaggerations which are too common with regard to the dangers incidental to milk and meat. Not one tuberculous cow in twenty yields milk containing tubercle bacilli, and in the immense majority of cases the flesh of animals that have suffered from tuberculosis is not at all dangerous for human food. This may be said to belong to the alphabet of the subject, but obviously it is not yet known to some of those who aspire to be leaders of public opinion with regard to the best methods of dealing with bovine tuberculosis. Mr Hunting also says, without any qualification whatever, that the flesh of tuberculous animals "is not a decent diet." It is a circumstance pregnant with warning to the Board of Agriculture. Probably not much less than 20 per cent. of the cattle (excluding calves) killed for food purposes in this country are tuberculous, and we have elsewhere pointed out as one of the obstacles to stamping out the disease that the moment the Government takes it in hand, ignorance of the facts and popular prejudice will render it necessary to confiscate the carcase of every tuberculous animal.

EDITORIAL ARTICLE.

THE STAMPING OUT OF GLANDERS.

THE Glanders or Farcy Order of 1894 has proved to be quite inadequate as a means of eradicating the disease from Great Britain. That is sufficiently attested by the statistics of the Board of Agriculture, which show that, while the number of cases reported in 1894 was 1437, the average number for the succeeding four years was 1475, and for last year 1385. Presumably in recognition of the inefficiency of the existing regulations, the Board of Agriculture in February last appointed a Departmental Committee to inquire into and report upon the working of the Diseases of Animals' Acts in so far as they relate to glanders, and to consider whether any more effective measures can with advantage be taken to prevent the spread of that disease. The Committee, which included representatives of Local Authorities, the large horse-owning companies, the veterinary profession, and the Board officials, examined twenty-four witnesses, and it has issued a report, the substance of which is printed at a later part of this number.

A perusal of the minutes of evidence given before the Committee reveals a quite remarkable unanimity of opinion on the part of both the professional and the lay witnesses with regard to the matters of main importance, and notably concerning the diagnostic value of mallein, and the necessity of having recourse to its aid if the disease is to be stamped out in the near future. The veterinary witnesses without exception—all of them entitled to speak with some authority from practical experience—declared their faith in the agent; and the lay executive officers and other representatives of Local Authorities were equally emphatic in expressing an opinion in favour of a more extensive use of the agent in dealing with outbreaks of glanders. Mr Alfred Spencer, Chief Officer of the Public Control Department of the London County Council, informed the Committee that a record which had been kept for the preceding ten months of cases in which suspected but not clinically glandered horses had been tested with mallein by or in the presence of the Council's inspectors, showed that during the period in question 544 animals had been so tested, of which 95 gave a full reaction to the test, and were found to be glandered on *post-mortem* examination. At this time of day it is

hardly necessary, at least in this country, to accumulate further evidence regarding the reliability of mallein as a test for the existence of glanders, but the fact just quoted, even if it stood alone, would suffice to convince any unprejudiced mind. It is true that in other instances brought to the notice of the Committee results not so absolutely satisfactory were obtained, but the general tenor of the evidence on this head guided the members of the Committee to the conclusion that "mallein is a very sensitive diagnostic agent."

Regarding one point touching the use of mallein, the Committee has certainly been led into error. The Report says that "the question whether reaction will or will not take place prior to the formation of lung lesions became of considerable importance in deciding that of the compulsory use of mallein, as assuming that reaction will not take place during the incubative period, it would, if the use of mallein were made compulsory, be necessary to make regulations for the detention of non-reacting horses for such a period—probably three weeks—as would ensure them, if they were glandered, reacting to a second test." This opinion appears to be founded on a statement made to the Committee by Mr Hunting. In answer to the question,[1] "May I take it that mallein discovers glanders in an occult or incubative stage?" Mr Hunting replied, "Not before there is a lesion in the lung. Nocard's experiments show that it requires about eighteen days before mallein will react in an infected horse. If you infect a horse on the first of the month, and try him with mallein every seven days, it is only the third injection that produces a reaction."

It is unfortunate that Mr Hunting should have made such an erroneous statement. In one series of experiments[2] Nocard infected four horses by feeding, and when he tested them with mallein *on the sixth day* afterwards the "reaction was so intense that for three days it was feared that they would die." In Nocard's second series of experiments the first mallein test subsequent to infection was made on the fifteenth day, and they "all reacted in the clearest manner." So far as we are aware these are the only experiments of the kind by Professor Nocard that have yet been published, and they do not afford any justification for the assertion that a horse will not react after infection until tubercles have formed in the lungs, while they prove that a pronounced reaction may be obtained in less than a week after infection.

In truth, however, the matter is not of great importance. The questions which were put to some of the witnesses and a number of expressions used in the report, with regard to the measures of isolation which it would be necessary to enforce in the case of reacting but apparently healthy horses, would be pertinent only if the risk of

1 "Minutes of Evidence, Question 2830."
2 *See* this "Journal," Vol. X., p. 301.

spreading the disease which attaches to those animals were completely safeguarded by the existing regulations. It is notorious, however, that at the present time this source of infection is allowed to have practically full play. The law as at present administered takes notice only of the clinically glandered horses, and does nothing whatever to check the dissemination of the disease by the already affected but apparently healthy horses which the inspector has before him in practically every outbreak of glanders. A perfect system of dealing with the disease might require that every horse in an infected stable should be quarantined until the mallein test declared it healthy, but since the law at present gives perfect freedom to the infected but apparently healthy horses as soon as the clinically glandered animals have been killed and the premises disinfected, compulsory use of mallein on all animals that have been exposed to contagion hardly seems to demand that suspected horses should be rigidly quarantined until they can be tested. Even if it had been necessary to test them three weeks after their last exposure to infection, to have allowed them to work in the interval would merely have left intact one possible source of infection—certainly the least fruitful—which is at present allowed full play. But, as we have already pointed out, there is no reason for insisting that the final test should be delayed for three weeks, and, indeed, the risk involved in granting a clean bill of health to animals that stand the test even the day after the discovery of the outbreak would be so small that in practice it might be neglected.

A point of much greater importance than the one just discussed is the question as to whether reacting but apparently healthy horses are capable of spreading the infection. The report states that the evidence on this subject was very contradictory. This is not what one might reasonably have expected, at least with regard to the opinions held by the veterinary experts, for surely nothing is more obvious than that the comparative failure of the existing Glanders Order is due to the fact that apparently healthy but in reality glandered horses are capable of spreading the disease, and that the Order takes no notice of them. Mr Hunting thought[1] that "there is very little risk of infection from the malleined horse that shows no clinical symptoms," and he did "not consider that horses showing no clinical symptoms are a real source of danger to the horse community." It appears probable from the context, however, that what Mr Hunting really meant by these statements was that until a horse becomes clinically glandered he is as a rule incapable of spreading the infection, and not that such an animal might not spread the disease by being introduced into a healthy stud and afterwards developing "clinical glanders." But even when thus interpreted, the opinion is, we believe, erroneous and mischievous. In considering this question it is necessary to remember that a clinically glandered horse is not always one with a visible source

[1] Questions 2756 and 2774.

of infection, such as an ulcerated septum or discharging farcy lesions. Very many—probably at the present time the majority—of the horses condemned and slaughtered as glandered exhibit no external symptoms of glanders except an enlarged and indurated submaxillary gland, or a thick leg, and no one would think of disputing the dangerous character of such animals. But, as a rule, neither the swollen gland nor the thick leg (provided it is not accompanied by farcy lesions) adds anything to the dangerous character of such a horse, whose real power for mischief resides in lung lesions that are discoverable only on *post-mortem* examination. Such an animal is often not one whit more dangerous than one which, but for the mallein test, might be passed by a committee of experts as perfectly healthy. It is no doubt true that the most dangerous animals of all are those with an ulcerated septum and a profuse nasal discharge, and those affected with farcy, but the lesions discoverable at the *post-mortem* examination of horses that show no external symptom, and, occasionally, the history of such animals, teach that an apparently healthy horse may spread the infection. To profess a contrary opinion is entirely inconsistent on the part of anyone who recommends the use of mallein on apparently healthy horses, for if only clinically glandered animals are dangerous to the horse community vigorous enforcement of the existing regulations is quite sufficient to stamp out the disease. Fortunately, the Committee, in spite of the conflicting evidence, arrived at the opinion that "it is desirable to consider horses that react to mallein as possible sources of danger."

It will be observed that the Committee, although convinced that mallein is a very sensitive diagnostic agent, were unable to recommend that the use of it should be made directly compulsory. It is doubtful whether the mallein test could be enforced without an Act of Parliament, and probably this influenced the Committee's decision on the matter. Practically, however, the recommendations in regard to suspected horses would, if effect were given to them, compel the owner to consent to the mallein test in every outbreak of glanders. These recommendations are to the effect that when glanders is found to exist all horses reasonably considered to have been exposed to the contagion, either on account of having been in the same stable, or compartment of a stable, as a diseased horse. or otherwise rendered liable to contagion, shall be dealt with in the same manner as suspected horses in so far as the Articles 6 and 9 of the Glanders or Farcy Order of 1894 apply to suspected horses. Article 9 here referred to practically prohibits movement of a suspected horse save for slaughter, and hence, if the recommendation of the Committee were put into force, all the horses in a stable out of which a glandered horse had recently been taken could be quarantined until, in the opinion of the veterinary inspector, suspicion no longer attached to them. It is recommended that when horses are thus

quarantined the owner may demand that they shall be tested with mallein, by and at the expense of the Local Authority, and animals thus found to be healthy are to be liberated, while those that react are to be slaughtered. Local Authorities would thus have power to isolate horses that have been exposed to contagion until the owner consents to an application of the mallein test to the whole of them, and doubtless most owners would prefer to submit their animals to the test rather than to have them confined to the stable for a prolonged period.

On the vexed question of compensation the Committee have made recommendations which will probably be considered unsatisfactory by the owners of glandered studs. In the case of clinically glandered horses the Committee consider that the compensation at present payable, viz., quarter value, with a minimum of £2, is sufficient. With this opinion we entirely agree, but scarcely for the same reason as those which appear to have influenced the Committee. The Report states that an animal that shows clinical symptoms of glanders is practically only worth the amount that could be obtained for the carcase, but "practically" some horses that present external symptoms of the disease may for a considerable time be as profitably employed as healthy horses, provided the owner is allowed to use them without any regard to the danger of the disease being conveyed to human beings or to the horses of his neighbours. It is this latter consideration—the fact that the working, and even the keeping alive, of a glandered horse is a menace to the public interests—that makes it quite equitable to value at carcase price a horse that is clinically glandered. Moreover, when account is taken of the dangerous character of a clinically glandered horse as a source of infection to his companions, it is generally in the interests of the owner himself to have the diseased animal destroyed.

It is not, however, with regard to this point that the recommendations of the Committee in the matter of compensation are likely to cause serious dissatisfaction on the part of horse-owners, but with regard to the compensation to be allowed for apparently healthy horses killed in consequence of reaction to mallein. For such animals the Committee recommend that "compensation should be on a higher scale than for clinically diseased horses, but in no case should the sum allowed for any horse exceed £25. In the event of a horse so slaughtered presenting no glanders lesions on *post-mortem*, the compensation shall be the value of the horse immediately before it was slaughtered, but so that the compensation do not in any case exceed £50."

Having regard to all the circumstances of the case, it must be admitted that the compensation here suggested does not err on the side of liberality. It is true, as we have already pointed out, that a horse which reacts to mallein, but appears healthy, may be, and in

every case ought to be, considered a dangerous horse, and it might be argued that the considerations which make carcase value equitable compensation for a clinically diseased horse apply here also. There are, however, other considerations which, from the point of view of compensation, place horses that merely react to mallein and horses that are visibly glandered in two different categories. The former are, as a whole, much less dangerous to the community than the latter, and under certain restrictions which do not appear to be quite impracticable owners of reacting horses might be allowed to use them without great risk of spreading the disease to the horses of other owners. Moreover, while a clinically glandered horse in the immense majority of cases continues to be a dangerous animal as long as it lives, we now have good reason to believe that a very considerable proportion of those cases of glanders which are undetectable without the aid of mallein recover from the disease, and cease to be at all dangerous. Several of the witnesses who gave evidence before the Committee suggested that, in view of this fact, authorities might have left to them the choice of compelling the slaughter of reacting horses or of placing them under a modified quarantine, which would allow them to be worked on the streets or highways, but would prohibit their sale or their removal to another stable until they had ceased to react. The Committee have not been able to recommend this plan, perhaps because they did not like to suggest that horses affected with glanders, even in the occult form, should, with the sanction of the law, be allowed to work on the streets. But, however that may be, the fact that a considerable number of horses recover even from that stage of glanders which, during life, is detectable only by mallein, ought in fairness to be taken into account in fixing the compensation for reacting horses slaughtered under the law. We are therefore in sympathy with the dissenting note signed by two of the members of the Committee—Colonel Colville and Mr Cope—in which the opinion is expressed that the compensation to be paid for horses slaughtered simply on the results obtained from the mallein test should be fixed in order to compel uniformity as to the amount paid by all Local Authorities, and that the sum paid should not be less than half the value of the horse before it became diseased, with a maximum of £25.

A considerable share of the attention of the Committee seems to have been directed to collecting opinions on matters of detail, which, although perhaps not absolutely devoid of importance, are certainly not in any material degree responsible for the success or failure of the regulations with regard to glanders. One would hardly think it matters much whether the disease is notified to a constable or to a veterinary inspector, but the Committee suggest that it ought to be made permissible to notify to either, and one of the members, Major Tennant, thinks this sufficiently important to require a special note

of dissent from him. In an immense number of cases, at the present time, notification is made to the veterinary inspector, although the law directs that it should be made to a constable.

The Report of the Committee remarks that there is need for further inquiry regarding quite a number of points that are still undecided, such as the precise method of infection, the period of incubation, etc. It is no doubt true that our knowledge regarding the subject is not perfect and complete, but we venture to think that for a good many years enough has been known to point the way to a complete eradication of the disease. That way is now known to the Board of Agriculture, and there will be much disappointment if it is not followed.

CLINICAL ARTICLE.

NOTES ON SOME ABDOMINAL OPERATIONS IN THE DOG AND CAT.

By FRED. HOBDAY, F.R.C.V.S., Royal Veterinary College, London.

Vomiting and Abdominal Pain relieved by Laparotomy.

THE following five consecutive cases are of the greatest interest, as in each of them the patient was in more or less acute abdominal pain, the history obtainable either being none at all or else one of a swallowed foreign body. After several drugs had failed to give relief an exploratory laparotomy was made under antiseptic precautions, the stomach and intestines being carefully manipulated without finding anything, and in each case the pain immediately disappeared, the relief usually being permanent.

CASE I.—October 1898. Dog, male, two years old, which had been suffering from persistent vomiting for the past three weeks. The animal was very thin, and could not retain either fluids or liquids. As no drugs gave permanent relief it was thought that there must be some foreign body present. An exploratory laparotomy was made, nothing being found to account for the symptoms. The animal escaped from observation for three days, but at the end of that time it was brought back and then ate food greedily and retained it. During the next three months all went well, but between January and April several similar attacks occurred, and were temporarily relieved by doses of orthoform. In April, after an especially bad attack, the owner decided to have the dog destroyed. The *post-mortem* revealed nothing to account for the symptoms.

CASE II.—1st December 1898. Cat, female, fifteen months old.

The animal appeared to be suffering from occasional fits of abdominal pain and great lassitude, the abdomen being pendulous and enlarged. The owner said the condition had persisted for about ten weeks; appetite was fairly good. As palpation externally revealed no signs of kittens or any foreign body, an exploratory laparotomy was made. Nothing was found, but the animal appeared to brighten up at once and made a good recovery.

CASE III.—1st December 1899. Fox terrier, male, six years old. The owner said the animal had swallowed a meat skewer. Being a little sceptical at the time, we treated the animal for a week with medicines; at the end of this time there was very great debility, partial paralysis of the hind quarters, and a considerable amount of œdema of the hind legs. Thinking then that probably the owner was right, an exploratory laparotomy was made; nothing, however was found. Improvement was immediate, the œdema disappearing and the animal brightening up wonderfully. The edges of the wound had adhered well on the third day and the external sutures were removed; the patient was sent home on the 6th. Re-inspection was made at intervals during the next three months, and there was no retnrn of the symptoms.

CASE IV.—19th May 1899. Retriever, male, nine years old, supposed to have swallowed an india-rubber ball. There was excessive abdominal pain, vomiting, no fæces had been passed for three days, and the animal appeared very weak and ill. An exploratory laparotomy was made without finding anything. Until the 22nd the dog appeared very dull, but then he suddenly brightened up and commenced to feed. Diet was given sparingly, and it was arranged for the patient to leave the infirmary on the 29th. Unfortunately, on the 28th the owner came to see how things were progressing, and, with mistaken kindness, gave the patient a heavy meal. The result was that the violent peristalsis set up caused re-opening of the abdominal wound and prolapse of the intestines. A dose of poison was then administered.

CASE V.—13th July 1899. Fox terrier, male, four years old, in acute abdominal pain for several days. Various drugs were tried without success for a week, and, feeling sure that there must be some foreign body present, exploratory laparotomy was performed. Nothing was discovered; recovery was uneventful, the patient leaving the infirmary on the 20th. The dog has been kept under observation until now, and with the exception of a little sore spot on the abdominal wall, due to a buried silkworm gut suture, it has had no further trouble.

A Case of Perineal Hernia.

On 13th July 1899, a bull dog was brought to the Clinique with a large swelling on the right side of the anus and perineum. The history given by the owner was that the animal had been in his possession for about seven months, and that he had observed the swelling for about three months. A longitudinal incision was made into it, and a piece of omentum which immediately slipped out was ligatured and excised, the stump being returned into the abdomen after carefully washing it with chinosol lotion. The edges of the skin wound were sutured and the whole was covered with iodoform collodion. The patient was

allowed to go home on the 15th, being brought each morning for inspection. On the 17th three sutures were removed, and recovery was uneventful.

The swelling can still be discerned, although very much reduced in size, and the owner has been advised to have another operation performed. If he consents I purpose doing a laparotomy in the median line, withdrawing the gut and omentum into its proper place, and suturing it to the abdominal wall—an operation which has several times been performed in a similar class of cases by Mr Henry Gray.

Intussusception; Reduction.

1st February 1899. The patient was a neuter cat, five years old, suffering from occasional vomiting and marasmus. Manipulation through the abdominal wall revealed a sausage-shaped swelling about 4 inches in length, which was diagnosed as an intussusception. Laparotomy was performed under an anæsthetic, the intestine being carefully pulled into its normal shape without much trouble, as, fortunately, no adhesions had as yet taken place. After progress was uneventful until the 9th, the animal feeding well and the wound being completely healed over. On the 9th it became dull and listless, the visible mucous membranes intensely yellow, and showed all the symptoms of acute jaundice. Death occurred on the 11th.

Post-mortem revealed acute congestion of the liver, all the tissues of the body being very yellow in colour. The intestines were in their normal situation, and the peritoneal wound had united splendidly, without a trace of pus.

Laparotomy and Massage of the Bowel for Obstruction.

In the following cases of obstinate constipation attempts were made to give relief by laparotomy, and, by gentle massage and manipulation, to break up the obstruction and pass on the pieces into the rectum.

CASE I.—4th February 1899. The patient, a valuable retriever dog, eight years old, had been under treatment for some time for obstruction of the bowels, having passed absolutely nothing for at least three weeks. The animal was continually straining to pass fæces and vomiting; it would drink water although this could not be retained, but it had for some days refused all food. It was now much emaciated, in continual pain, and very weak. Palpation of the abdomen revealed a hard mass in the lower part of the colon and upper part of the rectum, extending for fully 6 or 8 inches. The mass could just be touched with the middle finger inserted per rectum. Efforts were made to dislodge it with the fingers, by a blunt spoon, and by various injections, but all without result. The only chance of affording relief lay in immediate laparotomy and the removal of the mass by breaking it up and passing it on, or by enterotomy.

After consultation with Mr J. Dunstan. M.R.C.V.S., whose case it was, the patient was chloroformed, and an incision made in the median line, extending from the umbilicus to the brim of the pelvis. One hand was introduced and steady massage movements applied all round the bowel, great care being taken that no injuries were made with the finger nails. There were two masses in the rectum and colon, each about the size of a tangerine orange, and a third extend-

ing from the cæcum upwards for fully 5 inches; each felt as hard as a stone. Above this the gut was much distended and contained a lot of fluid fæcal matter. It took a little more than two hours before the mass could be broken up; it was then passed into the rectum and removed by Mr Dunstan either with the fingers or a blunt spoon. The gut was washed out with warm enemata. After consciousness had returned the dog seemed much relieved and out of pain, walking about and taking notice when spoken to. Beef tea or milk were administered every two hours, but towards midnight the patient became comatose, and it died at 4 A.M.

Post-mortem examination revealed intense congestion of the bowels, which had become enormously dilated; there were no signs of peritonitis, and I think that death must be attributed mainly to the great weakness, which prevented the animal from withstanding the shock of the operation.

CASE II.—2nd June 1899. A retriever dog, three years old. This animal had passed nothing for a fortnight, and was continually straining and in apparent discomfort. Purgative medicine and enemata had been given without effect. Palpation of the abdomen revealed a hard mass in the lower part of the gut. A portion was removed per rectum but, as the remainder could not be reached, laparotomy was decided upon. The bowel was carefully massaged for fifty minutes, but even then several hard masses remained and could not be broken up. These were removed by enterotomy, but, unfortunately, during the operation a quantity of bowel contents escaped into the abdomen. Fearing peritonitis, and that the weak state of the patient would make death a certain sequel, a toxic dose of hydrocyanic acid was administered before the dog became conscious.

CASE III.—18th August 1899. A retriever bitch, six months old, which had been observed by the owner to be straining violently for several days, passing at intervals minute quantities of black, fœtid, semi-fluid fæces. Palpation of the abdomen revealed distinctly an impaction of the lower part of the colon and upper part of the rectum, just out of reach of the finger or a blunt spoon. Laparotomy was performed, the hand being introduced and the bowel massaged for two hours before the hard mass could be broken up and passed on. Eventually it was all removed, and the dog appeared quite hearty and cheerful at night, eating the small quantity of food allowed with avidity. All went well until the 22nd, when she was noticed to be lying down a great deal more than usual. On the morning of the 23rd she was found dead. *Post-mortem* revealed an intussusception involving both small and large intestine, the intussuscepted part being quite purple. The abdominal wound was progressing satisfactorily.

Remarks.—I feel sure that the intussusception was not there at the time of operation; probably it was due to the peristaltic movement of the healthy part of the gut, thus tunnelling itself into the dilated, paralysed portion before the latter had time to recover its normal tone and size.

Gastrotomy.

CASE I.—10th April 1899. A fox terrier bitch, seven months old, was brought with a history of some obstruction in the gullet. She was very thin and weak and in great pain. An attempt to pass the

probang failed, although the obstruction could distinctly be felt; examination from the outside of the œsophagus gave no assistance. Laparotomy was performed on the median line, just behind the sternum. The foreign body could be distinctly felt in the thoracic portion of the œsophagus, but it could not be moved in any way. An incision just large enough to admit a strong pair of dressing forceps was made in the stomach wall, and the instrument was directed towards the cardiac orifice; it was passed up the œsophagus, and after a little manipulation a huge piece of hard gristle was withdrawn. The wound in the stomach wall was then carefully cleansed and sutured (Lembert's). Unfortunately death occurred at this stage, due, as was proved by the *post-mortem* examination, to internal hæmorrhage from rupture of the posterior aorta. The œsophagus was intensely inflamed and ulcerated for fully an inch above the cardiac orifice of the stomach, and the efforts to remove the piece of gristle had caused rupture of the aorta into the thoracic cavity.

CASE II.—13th January 1898. Cat, female, 18 months old, very ill and emaciated. Laparotomy revealed a meat skewer 3½ inches long in the stomach. Unfortunately, the sharp end had already caused a perforating ulcer, and peritonitis had been set up from the escape of some of the contents. The skewer was withdrawn, the ragged edges of the ulcer cut out, and the parts thoroughly cleansed with antiseptic. The wound was drawn together with a double row of sutures, the internal row passing right through the walls and the external row being of Lembert's pattern. The peritoneal cavity was swabbed out with wadding soaked in chinosol solution, and a drainage tube left in. On the following day the abdomen was washed out with warm chinosol solution, but death occurred on the 15th. *Post-mortem* revealed peritonitis.

An Interesting Case of Ascites.

2nd June 1899. The patient was a female mastiff, five and a half years old, whose abdomen had been noticed by the owner to be getting larger during the past four months. When examined by us the abdomen was very pendulous, and there was a considerable amount of œdema of the hind legs and great lassitude. The trocar and canula were inserted in the usual way under aseptic precautions, and five and a half gallons of fluid removed, a little warm chinosol lotion being injected up the canula afterwards. Immediate relief was perceptible by the patient's manner, and up to the present time (25th September) it has not become necessary to reapply the trocar, although there are signs leading one to think that the abdomen is slowly refilling.

Lithotomy.

CASE I.—6th April 1899. A cat, neuter, two years old, suffering from hæmaturia, but in fair condition. A small catheter was passed, several small calculi following it when withdrawn. Laparotomy was performed on the median line just above the brim of the pelvis. The urine was released from the distended bladder by a fine trocar and canula; the bladder was incised for about half an inch of its length and carefully swabbed out with chinosol lotion (1-500). Fine silk-worm gut sutures (Lembert's pattern) were inserted, and the abdominal

wound sutured in the usual way. Recovery was uneventful, the patient being sent home on the 17th.

CASE II.—13th April 1899. Irish terrier bitch, eighteen months old. Whilst making the incision in the abdominal wall during the operation of oöphorectomy I had the misfortune to cut into the bladder, which was much distended. A quantity of urine made its escape into the abdominal cavity. The edges of the wound were drawn together as quickly as possible with three Lembert's sutures of fine silkworm gut, and the oöphorectomy proceeded with. Recovery from both operations was uneventful.

CASE III.—5th May 1899. A cat, male, two years old, which had been suffering from acute cystitis for three days; not a very promising subject. An unsuccessful attempt was made to pass a catheter, also a bougie, as there was a calculus in the urethra. This was eventually removed, and, thinking that more were present, anterior pubic lithotomy was performed, and the bladder, which was intensely inflamed, was washed out with chinosol (1-500). The patient rallied from the operation, but died sometime during the night. *Post-mortem* revealed nothing worth recording.

CASE IV.—17th July 1899. A fox terrier, male, four years old, which had been ill for a week, in great pain and passing blood in its urine. Several calculi had been released from the urethra by the aid of a catheter on the 15th, and on the 17th more than thirty small calculi were obtained in the same way. Thinking that, as the dog still seemed in pain, there were probably more left in the bladder, I decided to perform anterior pubic lithotomy; several gritty particles were removed, and the interior, which was very much inflamed, was carefully cleansed, the wall being sutured (Lembert's). On the 18th, 19th, and 20th all seemed going on well, with the exception that the animal was very sulky and vicious, and would not feed. On the morning of the 22nd it was found dead. *Post-mortem* revealed the bladder wound to be united, and firm steady pressure did not force any urine out; there was no trace of peritonitis or anything to account for death beyond the empty state of the stomach and intestines, owing to the animal's refusal to taste food and vicious resistance to our efforts to administer it.

CASE V.—6th April 1899. Scotch terrier, male, six years old. The animal was much exhausted, showing symptoms of acute cystitis, several calculi being present in the lower part of the urethra. Some of these were removed with thin forceps, but, as the catheter could not be passed owing to the presence of more in the upper part of the canal, posterior pubic lithotomy was performed. A calculus about the size of a hazel nut was discovered in the fundus of the bladder, together with a number of small ones (about fifty altogether) in the bladder and urethra. Being unable to get rid of the latter (owing to their roughness and the way they were fixed in the mucous membrane), and so reopen the urethra, we were reluctantly compelled to destroy the patient before consciousness returned.

Reports and Abstracts.

REPORT OF DEPARTMENTAL COMMITTEE ON GLANDERS.[1]

Glanders in Human Beings.—In dealing with glanders, the fact that the disease is communicable to human subjects must not be disregarded, although a return obtained from the office of the Registrar General shows that during the period 1891-97 there were only twenty-seven deaths of human beings in England and Wales notified as having been due to glanders.

Administration.—The administration of the Glanders or Farcy Order of 1894 is in the hands of those bodies that are Local Authorities within the meaning of Sections 3 and 60 of the Diseases of Animals' Act of 1894, as is practically the case with all the Orders of the Board of Agriculture dealing with diseases of animals.

There would seem to be no reason why the Orders dealing with glanders should be administered by an authority different to that whose duty it is to execute and enforce the provisions of the other Orders dealing with diseases of animals, but we cannot lay too much stress on the need of obtaining uniformity of action by the various Local Authorities, and from the evidence presented to us we think much might be done in this direction by a more extended system of supervision by the central authority. The greater range of action of the officers of the central authority would also enable the origins of outbreaks to be more readily determined.

Notification of Disease.—The Committee recommend that Article 3 of the Glanders or Farcy Order of 1894 should be amended to permit of immediate notification of disease being made either to a veterinary inspector of the Local Authority or to a constable, but where the notification is made to the veterinary inspector it shall be obligatory on him to at once notify the police.

There is a general consensus of opinion that where practicable the local Veterinary Inspector should not be engaged in private practice.

Most of the witnesses were of opinion that it should be made obligatory for any veterinary surgeon to report the existence, or suspected existence, of any case of glanders that came under his observation; other witnesses were of opinion that such action was not necessary but that there was no objection to it.

The Committee recommend that legislation should be introduced making it obligatory on every veterinary surgeon in Great Britain to notify to such person as the Board of Agriculture shall direct all cases of glanders, or suspected glanders, of which he shall become aware.

We are of opinion that it is desirable to secure notification from knackers' yards of any cases of glanders found in animals taken to the yards for slaughter. We therefore recommend that all such cases should be notified by the occupier or owner of the yard to the Local Authority from whom such occupier or owner receives his licence.

[1] From the Report of the Departmental Committee appointed by the Board of Agriculture to inquire into and report upon the working of the Diseases of Animals' Acts in so far as they relate to Glanders.

Mallein.—It has been urged that power should be given for the compulsory use of mallein under certain circumstances, a suggestion that at once raises the question as to what action should be taken with regard to animals that react to the mallein test.

The evidence given before the Committee in regard to the use of mallein is somewhat conflicting. It appears certain that, judged by reaction to the injection of mallein, a considerable number of cases of disease are detected which would not have been diagnosed as glanders by the ordinary "clinical" signs. In most cases of this kind indubitable evidence of glanders is found *post-mortem*. It may also be true that mallein reaction discovers the existence of glanders in an occult or incubative stage. It rarely happens that any case with "clinical" or pronounced *post-mortem* evidence of glanders fails to react to mallein. Mallein is therefore a very sensitive diagnostic reagent.

The question as to whether reaction will or will not take place prior to the formation of lung lesions became of considerable importance in deciding that of the compulsory use of mallein, as assuming that reaction will not take place during the incubative period, it would, if the use of mallein were made compulsory, be necessary to make regulations for the detention of non-reacting horses for such period—probably three weeks—as would ensure them, if they were glandered, reacting to a second test.

It also raises the question as to what proportion of the value of an animal is to be paid as compensation should—on its being slaughtered on account of reaction to mallein—no glanders lesions be found on *post-mortem* examination.

The question of what action it is desirable to adopt with regard to animals which react to the mallein test, but are not "clinically" affected, depended a great deal on the extent to which such animals could be considered a source of infection. The evidence on this subject was very contradictory, some witnesses expressing the opinion that reacting horses are non-infectious, while others considered that such animals are as infective as those showing "clinical" symptoms. The Committee incline to the opinion that horses that show no "clinical" symptoms of glanders, but which react to the mallein test, are not so infective as those that show definite "clinical" symptoms. At the same time they are of opinion that the evidence shows that it is desirable, while the point remains doubtful, to consider such reacting horses as possible sources of danger.

Use of Mallein.—The Committee have, after due consideration, come to the conclusion that they cannot recommend that the use of mallein should be made directly compulsory.

The Committee consider that only such mallein as is obtained from sources approved by the Board of Agriculture should be deemed efficient for the purpose of testing animals.

Suspected Horses.—The Committee recommend that where glanders is found to exist, horses that the veterinary inspector may reasonably consider to have been exposed to the contagion, either on account of having been in the same stable, or compartment of a stable, as the diseased horse, or otherwise rendered liable to contagion, shall be dealt with in the same manner as suspected horses in so far as the provisions of Articles 6 and 9 of the Glanders or Farcy Order of 1894 apply to suspected horses; but when in the opinion of the veterinary inspector no further suspicion attaches to such horses they shall cease to be suspected horses, and if after one or more applications of the mallein test the veterinary inspector is satisfied that any such horse is affected with glanders that horse shall be slaughtered and compensation paid as mentioned in Paragraph 36.

The owner to have the right to demand that any horse detained as above shall be tested with mallein by and at the expense of the Local Authority.

Slaughter.—The existing regulations give Local Authorities permissive powers as to slaughtering all animals affected with, or suspected of being affected with glanders; but should the owner object to slaughter the Local Authority must then first obtain special sanction from the Board of Agriculture before slaughter can be carried out.

This system has caused considerable difference in the action taken by various Local Authorities; and where one Local Authority has been in the habit of exercising its powers as to slaughter, and an adjacent Local Authority has not, there is reason to believe that affected animals are sometimes moved from the non-slaughtering district to the slaughtering district prior to notice of the existence of the disease being given.

The Committee recommend, therefore, that it should be made obligatory for every Local Authority to slaughter every horse, ass or mule within their district that shows "clinical" symptoms of glanders.

Compensation.—The question of compensation comes under two heads:—

(*a*) The source from which the funds are to be obtained.

(*b*) The proportion of the value of the animal that is to be paid as compensation.

At present the expenses of compensation are defrayed by local taxation. It has been suggested in evidence that the compensation should be taken from Imperial funds. This system would necessitate the expenditure being controlled by officials appointed by the Treasury, which would also mean that the existence, or non-existence, of disease in any animal for which compensation was to be paid would have to be confirmed by officers solely under the control of the Treasury—that is to say, by officers of the Board of Agriculture. Any such system would, the Committee think, necessitate a considerable increase in the present staff of the Board, and it would be necessary to apply to Parliament for a grant to defray the cost, or for authority to charge it to the Cattle Pleuro-pneumonia Account. In the latter case, assuming that the same system was adopted as with regard to swine-fever, it is doubtful whether even in those districts in which a comparatively large amount of glanders exists the sum deducted from the Local Taxation Account would be less than that now expended in dealing with glanders. The Committee, therefore, do not recommend any change in the system by which the funds for the defrayment of the expenses incurred in dealing with glanders are at present provided.

The compensation at present payable in the case of slaughter of an animal that is affected with glanders is such a sum as the Local Authority think expedient, with a minimum of £2 in the case of a horse, and of 10s. in the case of an ass or mule, provided that in no case shall the compensation, if above the said minimum, exceed one-fourth of the value of the animal immediately before it became diseased.

Considering that an animal that shows "clinical" symptoms of glanders is practically only worth the amount that could be obtained for the carcase, the Committee are of opinion that the compensation as above-mentioned is sufficient in those cases in which the animal shows definite "clinical" symptoms prior to slaughter.

But in the case of animals showing no "clinical" symptoms, and in which slaughter is carried out as a result of reaction to the mallein test, the Committee consider that compensation should be on a higher scale than that for a "clinically" diseased horse, but in no case should the sum allowed for any one horse exceed £25. In the event of a horse so slaughtered presenting no glanders lesions on *post-mortem*, the compensation shall be the value of the horse immediately before it was slaughtered, but so that the compensation do not in any case exceed £50.

Registration and Supervision of Stables.—It was suggested by some

witnesses that regulations should be made for the registration and supervision of stables. In some cases the suggestion was that any such regulations should only apply to trade stables, in others that they should apply to all stables. The reasons advanced for the introduction of such regulations were twofold: firstly, to enable inspectors of Local Authorities to enter any stable at any time; secondly, to enable Local Authorities to insist on improved sanitary conditions, even to the extent of structural alterations.

As regards the latter reason the evidence before the Committee is to the effect that the construction and general sanitary condition of a stable has no connection with the introduction of glanders into that stable. It would appear that registration of stables as regards such purposes is unnecessary.

As regards giving inspectors of Local Authorities right of entry into any stable, Section 44 (2) of the Diseases of Animals' Act, 1894, gives an inspector power to enter any building or place wherein he has reasonable grounds for supposing that any order of the Board of Agriculture or a regulation of a Local Authority has not been, or is not being, complied with.

Imported Horses.—The risk of the introduction of glanders by imported horses seems by the evidence submitted to the Committee to be very small, and it therefore would be undesirable to put on a very important industry restrictions that would give most inadequate results for the expense incurred and the disturbance of trade that would take place. At the same time the Committee consider that Local Authorities should take steps for the attendance of a veterinary inspector at the landing of imported horses at ports within their jurisdiction.

Further Research Required.—We have considered it to be no part of our reference to enter largely into the history and pathology of glanders, though it is necessary to remember that in devising methods for the restriction of the spread of the disease, regard must be had to the latest reliable information which scientific research has placed at our disposal. The evidence we have taken from scientific experts indicates many points on which there is conflict of opinion, and in which further investigation may lead to a change of view as to the practicability of stamping out glanders or curing the disease when it has not progressed beyond a certain stage in an infected horse. Such suggestions as we make in this Report are based upon current views of leading veterinarians, but we feel that further research is needed on some of the most elementary facts of the disease before our means of prevention, or treatment, can be formulated with scientific exactness. Thus the mode of propagation, whether ærial, or by contagion, or by inoculation, or by ingestion, needs further elucidation; as also the question of the degree of infectiveness attaching to early or occult cases of the disease. The incubation period can hardly be regarded as certainly defined. The refractiveness to mallein needs explanation when this occurs after previous reaction has indicated the presence of disease; with this is associated the undecided question of the possibility of spontaneous cure, or remedial action of mallein. We understand that the Board of Agriculture are engaged in experiments having the solution of some of these problems for their object, and we could have wished that the results had been at our disposal before concluding our Report. As it is we can only endorse the necessity for such authoritative inquiry.

A PROTEST AGAINST EXAGGERATION.[1]

THIS, I may remind the Association, is not the first occasion upon which we have discussed tuberculosis and its prevention, but I imagine that nobody here will object to its reappearance on our Agenda paper. Notwithstanding the great amount of attention that has been given to the subject during the last half-century, and more particularly during the last twenty years, it cannot by any means be said that our knowledge regarding it is so complete as to make further discussion superfluous or uninteresting. It is true that many points that were wont to be the subject of fierce dispute have now been relegated to the category of truths that are universally accepted, but there still remain many points connected with this subject that are open to legitimate difference of opinion, as I have no doubt this discussion will prove.

Mr Dunstan says, in the opening paragraph of this paper, that tuberculosis of cattle is the most burning question of the day, not only to us as veterinary surgeons, but to the medical profession, municipal and other public authorities, and the public generally. Now, I am not by any means going to say that tuberculosis is not a highly important subject; but I am bound to say that when I read that it struck me there was an element of exaggeration about it, because it seems to imply that bovine tuberculosis transcends in importance every other disease, not only for veterinary surgeons, but also for stock-owners, the medical profession, and the general public. Now, with your kind indulgence, I should like to devote a minute or two to examine the circumstances from which tuberculosis of cattle derives whatever importances it possesses. In the first place, tuberculosis of cattle has an undoubted economical importance. It is a disease that affects the health of our cattle, kills some of them, and deteriorates the value of others. That is an importance which might be estimated or stated, if we were fully acquainted with it, in pounds, shillings, and pence, but I am not aware where one can find any information upon which an estimate making any pretension to accuracy as to the extent of this loss could be based. I am inclined to think, however, that the economical importance of tuberculosis at the present time is sometimes overestimated, distinctly exaggerated. From this point of view tuberculosis of cattle does not come into the same category at all as, for example, cattle plague or pleuro-pneumonia, because when these diseases were prevalent in this country visitations of them frequently brought individual farmers to the verge of ruin, or even to actual bankruptcy. Now, so far as my information enables me to form an opinion, it leads me to think that the losses of farmers —the actual money losses of farmers—from tuberculosis are seldom serious, except when there has been some gross neglect of such simple precautions in the way of prevention as the removal of animals that are obviously ill and dying from the disease. If I am wrong in this estimate, then subsequent speakers will no doubt put me right, But before I leave that point I should like to say that I want something more to prove the loss inflicted by tuberculosis on farmers and stock-owners than a mere reference to cases in which a very large percentage of animals were found to be affected with the disease when the stock was subjected to the tuberculin test. As a matter of fact, that is hardly any evidence that the owners of these animals have sustained loss or injury from the disease among their stock, because I am quite sure it must have been the experience of a great many of the members here who have been employing the tuberculin test that a stock-owner may find, when he tests his animals, that he has 20 or 30 per cent. of them affected, and yet

[1] Verbatim report of a speech made by Professor M'Fadyean in opening the discussion on Bovine Tuberculosis at the annual meeting of the National Veterinary Association, 1899.

he may not have lost a single animal from tuberculosis, or noticed any deterioration of their health in the preceding years. In fact, it is my opinion that a stock-owner may have tuberculosis among his cattle for many years and sustain no loss at all.

The second respect in which tuberculosis is an important disease is that it is communicable, and in all probability is occasionally communicated to the human subject—I mean that tuberculosis of cattle is communicable, and in all probability is communicated sometimes to the human subject. But I think that here also it is necessary for one to guard against dropping into exaggeration. I think I am justified in saying that in the past exaggeration has been freely indulged in by many of those who have sought to trace a connection between the human and the bovine disease. There never was, in my opinion, the slightest justification for the assertion that human phthisis frequently comes from the butcher's shop. I think it is exceedingly doubtful whether any cases of pulmonary consumption in man, which is the rampant form of tuberculosis in the human subject, ever originated from bovine tuberculosis, and I think the evidence also justifies the opinion that at the most only a small proportion of the other forms of tuberculosis in man come from either meat or milk. Quite recently an effort has been made to show that there is a rather close connection between the use of tuberculous milk and one form of tuberculosis in the human subject, by examining the returns of the Registrar General with reference to deaths recorded under the head of tuberculosis. These returns appear to show that, during the last fifty years, there has been a very remarkable decline in those forms of tuberculosis which are due to ærial infection; but that this decline has not extended to those forms of tuberculosis, notably to what is known as tabes mesenterica, which are generally ascribed to infection by way of the alimentary canal, and it has been sought to interpret these facts in this way. It is said that the reduction in the prevalence of the forms of tuberculosis due to ærial infection is due to the great improvements which have been effected during the last fifty years in the hygiene of human habitations, such as improvements in lighting, drainage, and ventilation, which naturally tend to diminish pulmonary consumption. On the other hand, it is contended that tuberculous milk is one of the main causes of tabes mesenterica, particularly in children, and that during the last fifty years there has been little or no decline in the prevalence of that form of the disease, because the improvements in hygiene to which I have just referred have not struck at this method of infection, and because it is said that at the present time and during recent years milk enters more largely than it used to into the dietary of young children. Now that sounds rather a formidable indictment of milk as a cause of tuberculosis. But I think there is one distinct flaw in the chain of evidence which it is thus attempted to forge, for when one comes to examine the statistics one finds that there has actually been a decline in the number of cases of tabes mesenterica in children over a year; that is to say, in children of one, two, and three years of age there has been a decline in the number of cases of tabes recorded, and the increase has affected only children under twelve months old. Now that is not what one would have expected if the consumption of tuberculous milk had been the main cause, or a main cause of consumption of the bowels in the human subject, because I think everybody will admit that at the present time, as well as in the past, milk enters more largely into the dietary of children in the second year than during the first, and if anybody denied that, I still should be inclined to say that the statistics do not establish a close connection between tuberculous milk and tabes mesenterica, because even if milk were as largely used during the first as during the second year of childhood one would expect that a considerable number of children infected during the first year would survive over the age of twelve months, and thus swell the statistics of the second year.

But somebody may say, does all this mean that there is no connection at all between tuberculosis of cattle and human tuberculosis? By no means. I think nobody who has examined the evidence can doubt that products derived from tuberculous animals must occasionally be the cause of the disease of the same name in human beings. It is no use, in order to discredit such a view, to call for precise evidence, because even if anyone of us were infected with tuberculosis by eating a piece of infected meat, or drinking tuberculous milk, in view of the long period of incubation, and the manifold risks of infection from human sources to which we are all exposed, it would be next to impossible for us to point to the actual time or agent of infection. But although I think that too much importance is still attached to tuberculous milk as a cause of human tuberculosis, I maintain that there is evidence to show that there is a distinct menace to human health existing at the present time through the prevalence of tuberculosis among cattle. We know that in almost every part of the kingdom milk containing tubercle bacilli is occasionally being sold. In many places it is being sold more than occasionally. We cannot trace the effect of that milk directly to human beings, but we know that whenever we get hold of such milk and test it we find it possessed of the most deadly properties, and there appears to be no escape from the conclusion that it must be affecting a certain proportion of human beings.

I come in the next place to notice what is the most interesting part of Mr Dunstan's paper, the part which deals with the measures appropriate to prevention. I am afraid that in spite of the proverb which says that "prevention is better than cure," the public are apt to measure our competency as a profession by our ability to restore sick animals to health. But we must all bear the reproach that we do not know how to cure tuberculosis in cattle. It is true that when tuberculous animals are well kept some of them recover, and in a great many others the disease never reaches a stage that sensibly affects the wellbeing of the animal. But we have to admit that we know no drug or agent which will restrain the activity of the tubercle bacillus within the animal body. On the other hand, we do know how to prevent the disease, and so far from desiring to keep that knowledge to ourselves we take this and every similar opportunity to proclaim to the public the method by which, in our opinion, the disease can be stopped. In a general way prevention may be said to be simply the application to this particular case of the principles that have been successful in dealing with the other contagious diseases—that is to say, measures have to be directed to prevent the spread of tubercle bacilli from one animal to another. Mr Dunstan arranges his suggestions with regard to prevention under the head of the so-called legislative and voluntary measures. The legislative methods are arranged on page 59 of the papers. But when one comes to examine the so-called legislative measures, one finds for the most part they are not compulsory, but are optional, and as I understand them, the Government is merely to advise that the measures which are supposed to be appropriate should be followed.

That at any rate applies to the use of tuberculin. But compulsory notification and immediate slaughter of animals clinically tuberculous are to be insisted upon. I am very thankful that it is not the business of the person who has to open a discussion to construct a scheme to take the place of one upon which he is prepared to offer destructive criticism. Although I have, in common with many other members here, given a good deal of thought to the subject of tuberculosis, I am not prepared to formulate a scheme for the stamping out of tuberculosis. It would be, perhaps, going too far to say that it would be impossible, within a brief period of years, to exterminate tuberculosis among cattle, but I think there is ample justification for the statement that having regard to the cost, the extermination of the disease within the near future is practically impossible. I should object to the

application of Mr Dunstan's scheme of legislation, because I believe it would be enormously costly, and the results obtained would not be at all in proportion to the amount of money expended. Mr Dunstan suggests the general use of tuberculin. Now, has anybody taken a pencil and sat down for a few moments and calculated what it would cost to test all the animals in this country with tuberculin, even once? It would cost half a million. But in order to exterminate tuberculosis from Great Britain, one would require to test the bulk of the cattle, not once, but many times. But then Mr Dunstan will say that he never suggested that everybody was to test his animals. It is to be optional, and only those who wish it are to have their cattle tested. My reply to that is that if it is optional it is not a scheme for stamping out—that the method would fail just in proportion as stock-owners refrained from applying to have their animals tested with tuberculin. You will observe that Mr Dunstan says the legislative method is the only rational one. Now, if I am not mistaken, the methods which Mr Dunstan describes as voluntary are precisely those which he himself has induced a number of his own clients to undertake, and it is therefore surprising to find Mr Dunstan inferentially describing his own methods as irrational. In this case I am prepared to defend Mr Dunstan against himself, and to maintain that the application of reasonable measures to the eradication of tuberculosis by a stock-owner, without compulsion and without State assistance, is absolutely rational, and that in the meantime our efforts should be, I think, mainly directed to the education of the farmer and the general public, and to inculcating upon the farmer the fact that it will pay him to attack tuberculosis without waiting for the time—perhaps in the remote future—when the Government will compel him to stamp it out. I am afraid I have occupied an unreasonable amount of time in discussing in a general way Mr Dunstan's paper, and I have not left myself time to deal with one or two particulars, but with your permission I will say one or two words more regarding the methods which Mr Dunstan recognises as voluntary.

The first of these is that the owner should test the whole herd for tuberculosis, and put all those which react into a separate herd and feed off for slaughter as quickly as possible. I think it would be very difficult to improve on that. I think that is a distinct improvement upon what is generally known in this country as the Danish plan, which consisted in testing the animals, making a partition in the cow-shed, and putting those which reacted on one side, and those which did not react on the other, and continuing to milk the cows for years, gradually working them out. I think it is better, although probably it sometimes involves a greater initial sacrifice, to get rid of the animals as soon as possible for butchers' purposes. In the second place, Mr Dunstan advised that the test should be repeated yearly. Now, I do not think that the repetition of the test once in twelve months is enough, and experience has shown that the stock-owner who thinks that he can by one application of the tuberculin test, followed by the prompt separation of those that react, exterminate the disease, will be disappointed. I think it is an all-important point in connection with the use of the tuberculin test that it should be repeated within a few months of its first application, because, although tuberculin is a test of marvellous reliability, it would be a distinct exaggeration to say that it is perfect. It is not infallible, and when one tests a large number of animals in most cases I think probably one or two affected animals are left in the herd after one has separated those that reacted. In other words, occasionally when one tests a large stock of animals with tuberculin there are some already affected which will not react. If these are left in the stock for twelve months, that gives ample time for infection of a very large proportion of the animals that are healthy. It is, I think, a point of great importance to know that if a stock-owner wishes to absolutely exterminate

the disease he must repeat the test on the non-reacting animals within three months, and after that, if he is wise, he will repeat the test not yearly but half yearly.

Then Mr Dunstan says that the milk from all reacting cows is to be sterilised and used for feeding calves and pigs. I am not prepared to go so far as Mr Dunstan does in that respect. I feel it would be useless to offer such advice to farmers in the meantime, because how is a farmer who makes this sacrifice to compete in the market with his neighbour who makes no such sacrifice? That is to say, the one farmer tests his cattle and sacrifices 20 or 30 per cent. of his cows—because the sale to a butcher involves some sacrifice—and he resolves that for the future he will sell only milk from cows that do not react to tuberculin. How is he, then, to compete in the market with the owner who keeps 20 per cent. to 30 per cent. of his animals tuberculous? The answer is, that at the present time he cannot compete. By and by, perhaps, he will be able to compete, when we have awakened public opinion to such a pitch that the milk consumer will demand to have milk with a guarantee that it comes from animals that do not react to tuberculin.

The last point upon which I should like to touch is this. I have rather deprecated the interference of the State up to the present time with tuberculosis of cattle. I think it would be hopeless on the part of the Board of Agriculture to attempt to exterminate tuberculosis by following the lines that were successful with other diseases, such as pleuro-pneumonia and cattle plague.

Mr HUNTING: Or glanders.

Professor M'FADYEAN: Or glanders. I think the experience with regard to glanders in London is a distinct warning to the Board of Agriculture not to be persuaded by Mr Hunting, and others who favour his method of reasoning, to adopt the same methods to tuberculosis. But I should not like to sit down without saying that I think enough has not been done, and enough is not being done, to deal with tuberculosis in the direction of lessening the risk to which human beings are at present exposed from the sale of tuberculous milk. As many of you are doubtless aware, an Order was issued during the course of the present year amending the Dairies, Cow-sheds, and Milkshops Order so as to give Local Authorities power to deal with cows affected with tuberculosis of the udder. Now, that is a step in the right direction, but it by no means goes far enough, because the power conferred by that Order relates only to animals that are kept within the district of the Local Authority, and it is an exceedingly poor protection for large cities, such as London, which derive their milk supply mainly from outside sources. So I think that what the public should agitate for is an extension of that power, so that a Local Authority may be able to deal with the milk sold within its district, and to deal with the owner of the cows providing such milk, no matter where those cows are kept. Such powers as these have been sought for, and I believe obtained, during the present session of Parliament by one or two large cities in England—Manchester and Leeds, I think. Another extension of the law that ought to be insisted upon is that owners of cows with tuberculous udders ought to be compelled to notify. At the present time notification is not compulsory. I think that owners ought also to be compelled to notify symptoms of tuberculosis of any sort in a cow that is giving milk. I do not think that the Board of Agriculture should insist on the slaughter of these animals, at any rate I do not think it would be wise to grant compensation. At the present time almost the only losses experienced by cattle owners through tuberculosis occurring among their stock are those which result from keeping on, long after they ought to be killed or otherwise disposed of, animals obviously affected with tuberculosis. If you are going to offer compensation to a man for a cow that is dying from tuberculosis you will remove almost the only incentive that he has at the present time to take measures to get rid of the disease.

ROYAL VETERINARY COLLEGE, LONDON.

List of Bursaries, Medals, Honour Certificates, Etc., 1898-99.

Coleman Prizes.

Silver Medal	G. H. Wooldridge.
Bronze Medal	J. M'Ilvenna.
Certificate of Merit	D. H. Rait.

Centenary Prizes.

Class A	H. E. Gibbs.
Class B	F. W. Robards.
Class C	C. Tyler.
Class D	G. H. Wooldridge.

Royal Agricultural Society's Medals.

Silver Medal	G. Lockwood.
Bronze Medal	H. S. Elphick.

Clinical Prizes.

Class A.

First Prize, £5	G. Sutton.
Second Prize, £3	W. P. Loft.
Third Prize, £2	H. E. Gibbs.

Class B.

First Prize, £5	S. F. G. Pallin.
Second Prize, £3	J. Adamson.
Third Prize, £2	P. J. L. Kelland.

Class C.

First Prize, £5	R. J. Collings.
Second Prize, £3	C. Tyler.
Third Prize, £2	H. Thackeray.

Class D.

First Prize, £5	A. Robb.
Second Prize, £3	H. S. Elphick.
Third Prize, £2	G. Lockwood.

Class Prizes.

Class D.

MEDICINE.—*First Prize*—G. H. Wooldridge. *Second Prize*—J. M'Ilvenna. *First-Class Honour Certificates*—A. M. Brodie, J. Cane, J. L. Frood, J. J. Garside, W. G. Girvan, G. Lockwood, E. Little, J. H. Poles, D. J. Quinlan, C. E. Rix, C. Roberts, D. H. Rait, A. Robb, J. J. B. Tapley, J. M. Tate. *Second-Class Honour Certificates*—H. S. Elphick, H. H. Jeffries, J. Lee, P. J. Maher, J. Maguire, W. R. Neale, A. L. Purdy, R. A. Plunkett, J. A. Russell, C. M. Sharpe, E. L. Siddall.

SURGERY.—*First Prize*—G. H. Wooldridge. *Second Prize*—J. L. Frood and C. E. Rix (æq.). *First-Class Honour Certificates*—J. M'Ilvenna, D. H. Rait. *Second-Class Honour Certificates*—H. S. Elphick, J. J. Garside, W. G. Girvan, G. Lockwood, J. Maguire, J. H. Poles, D. J. Quinlan, C. Roberts, A. Robb, E. L. Siddall, J. J. B. Tapley, J. M. Tate.

Class C.

PATHOLOGY.—*First Prize*—C. Tyler. *Second Prize*—C. E. Steel. *First-Class Honour Certificates*—R. J. Collings, J. A. Dixon, E. S. Gillett, J. T. Share-Jones, H. Thackeray, E. J. Wadley. *Second-Class Honour Certificates*—H. H. Aldred, G. H. Broad, P. V. Beatty, P. T. B. Basset, G. H. Barber, H. Cooper, F. Crossley, H. Greenfield, K. Hewlett, S. Jethiji, A. Leaning, E. Nicholson, H. A. Reid, G. Tucker.

HYGIENE.—*First Prize*—J. A. Dixon and C. E. Steel (æq.). *Second Prize*—T. Parker. *First-Class Honour Certificates*—H. Cooper, E. S. Gillett, H. Thackeray, C. Tyler, E. J. Wadley. *Second-Class Honour Certificates*—D. A. Aitchison, R. Burt, P. V. Beatty, F. Crossley, H. Greenfield, A. Leaning, G. May, J. Nicholas, W. S. Stevens, J. T. Share-Jones, G. Tucker, L. M. Verney, C. W. Wilson, H. E. Whitemore.

MATERIA MEDICA.—*First Prize*—R. J. Collings. *Second Prize*—E. S. Gillett. *First-Class Honour Certificates*—H. H. Aldred, J. A. Dixon, K. Hewlett, C. E. Steel, H. Thackeray, C. Tyler, E. J. Wadley. *Second-Class Honour Certificates*—P. T. B. Basset, H. Greenfield, S. Jethiji, A. Leaning, E. Nicholson, T. Parker, J. T. Share-Jones, G. Tucker, L. M. Verney, C. W. Wilson.

Class B.

ANATOMY.—*First Prize*—F. W. Robards. *Second Prize*—S. F. G. Pallin. *First-Class Honour Certificate*—E. C. Webb. *Second-Class Honour Certificates*—J. Adamson, G. S. Bruce, G. Crowhurst, W. H. Edwards, A. Littlejohn, E. S. Oliver, E. M. Perry.

HISTOLOGY.—*First Prize*—R. Paine. *Second Prize*—E. C. Webb. *First-Class Honour Certificates*—J. Adamson, E. P. Argyle, J. R. Baxter, G. S. Bruce, W. H. Chase, J. Harrison, J. Hobday, S. F. G. Pallin, E. M. Perry, F. W. Robards, R. J. Sargent, W. E. Schofield, J. R. Steevenson. *Second-Class Honour Certificates*—J. T. Angwin, G. Crowhurst, J. L. Cooper, A. A. Donelly, W. H. Edwards, A. Edgar, H. H. S. George, L. G. Gryspeerdt, A. W. B. Hodson, F. Hopkin, H. D. Jones, R. E. Klyne, A. Littlejohn, E. S. Oliver, G. H. Rainforth, S. J. Young.

PHYSIOLOGY.—*First Prize*—E. C. Webb. *Second Prize*—F. W. Robards. *First-Class Honour Certificate*—S. F. G. Pallin. *Second-Class Honour Certificates*—J. Adamson, E. P. Argyle, J. R. Baxter, G. S. Bruce, W. H. Chase, L. G. Gryspeerdt, J. Harrison, J. Hobday, H. D. Jones, A. Littlejohn, E. S. Oliver, W. T. Olver, R. Paine, E. M. Perry, A. G. Saunders, W. E. Schofield.

Class A.

CHEMISTRY AND TOXICOLOGY.—*First Prize*—G. P. Male. *Second Prize*—S. Dodd. *First-Class Honour Certificates*—C. Foster, H. E. Gibbs, G. Sutton, P. G. Short, C. W. Townsend, H. Turnbull, A. N. Watson. *Second-Class Honour Certificates*—T. S. Green, A. Goodall, J. R. Godbold, W. Jürgenson, W. L. Little, W. P. Loft, J. O. Muntz, H. Newton, G. E. Owen, A. V. W. Sewell, C. H. Sheather, W. G. Wragg.

PRACTICAL CHEMISTRY.—*First Prize*—S. Dodd. *Second Prize*—A. N. Watson.

BIOLOGY.—*First Prize*—H. E. Gibbs. *Second Prize*—G. P. Male. *First-Class Honour Certificate*—T. S. Green. *Second-Class Honour Certificates*—S. Dodd, C. Foster, A. Goodall, J. O. Muntz, C. W. Townsend, H. Turnbull, A. N. Watson.

MINOR ANATOMY.—*First Prize*—H. E. Gibbs. *Second Prize*—H. Turnbull. *Second-Class Honour Certificates*—S. Dodd, C. Foster, T. S. Green, G. P. Male, G. Sutton, C. W. Townsend.

PASS LIST.

The following are the Pass Lists [1] of this Institution for Session 1898-99.

FIRST PROFESSIONAL EXAMINATION.

Messrs B. H. Benson, A. A. Donelly, A. Edgar, N. Gilford, M. J. Kelly, R. E. Klyne, W. G. Litt, A. C. Lloyd, R. Morford, G. H. Rainsforth, J. R. Steevenson, R. P. Williams, G. H. Ward, *S. Dodd, C. Foster, T. S. Green, *A. Goodall, *J. R. Godbold, *H. E. Gibbs, W. N. Jürgenson, W. P. Loft, *L. M. Magee, *G. P. Male, *J. O. Muntz, H. Newton, G. E. Owen, F. O. Parsons, W. C. C. Radcliff, A. W. V. Sewell, C. H. Sheather, P. G. Short, G. Sutton, C. W. Townsend, *H. X. Turnbull, W. G. Wragg, A. H. Watson.

SECOND PROFESSIONAL EXAMINATION.

Messrs T. G. Bush, W. G. Evans, G. May, R. E. Mosedale, *J. Nicholas, W. M. Rowston, C. E. Turvill, *H. E. Whitemore, *R. H. Pinching, R. Peddie, *J. Adamson, †J. T. Angwin, *E. P. Argyle, *J. R. Baxter, *G. S. Bruce, W. H. Bradley, W. H. Chase, J. L. Cooper, D. R. Davis, *W H. Edwards, H. H. S. George, L. G. Gryspeerdt, F. Haigh, *J. Harrison, *A. W. B. Hodgson, F. Hopkin, J. Hobday, *H. S. Howard-Jones, *H. P. Jones, *A. Littlejohn, *E. S. Oliver, *W. T. Olver, †R. Paine, †S. F. G. Pallin, *E. M. Perry, †T. W. Robards, *R. J. Sargent, A. G. Saunders, *W. E. Schofield, *E. C. Webb, *S. J. Young.

THIRD PROFESSIONAL EXAMINATION.

Messrs H. G. Allen, H. Burrell, F. W. Cousens, D. S. Dickman, D. G. Galt, C. T. Hearn, *G. T. Jackson, B. L. Lake, H. Mosely, G. V. M'Naboe, J. C. Munby, J. P. Stableford, A. Spicer, J. E. L. Still, E. A. Wilshaw, D. A. Aichison, *H. H. Aldred, G. H. Broad, *P. V. Beatty, P. T. B, Basset, *G. H. Barber, *J. Chalmers, E. Child, H. Cooper, *R. J. Collings, F. Crossley, *J. A. Dixon, *E. S. Gillett, H. Greenfield, *K. Hewlett, A. Leaning, T. E. Mason, H. A. Reid, R. Stokoe, C. E. Steele, J. G, Share-Jones, H. Thackeray, C. Tyler, G. Tucker, The Kumar Shri Jethiji, L. M. Verney, *E. J. Wadley, C. W. Wilson.

[1] In this and the succeeding Pass Lists † indicates with First-Class Honours, and * with Second-Class Honours.

FINAL EXAMINATION.

Messrs E. A. Batt, W. Cranston, E. T. Goodall, *H. Gamble, *F. H. Ingersoll, C. H. Hylton-Jolliffe, G. P. Knott, J. M'Leod, †P. J. Simpson, T. J. Symes, J. C. Sanderson, J. P. Heath, J. Robertson, J. J. Kelly, R. C. Bell, A. M. Brodie, *J. Cane, *H. S. Elphick, H. W. L. Fernandes, J. L. Frood, J. J. Garside, W. G. Girvan, E. A. Hudson, G. Lockwood, J. Lee, *J. M'Ilvenna, J. D. Maguire, W. R. Neale, J. H. Poles, R. A. Plunkett, D. J. Quinlan, D. H. Rait, *C. E. Rix, C. Roberts, *A. Robb, C. M. Sharpe, *J J. B. Tapley, J. M. Tate, †G. H. Wooldridge, W. R. Kennedy, S. G. Chellew, R. C. Baxter.

ROYAL (DICK) VETERINARY COLLEGE, EDINBURGH.

PASS LIST.

The following are the Pass Lists of this Institution for Session 1898-99.

FIRST PROFESSIONAL EXAMINATION.

Messrs H. Mackay, J. W. Rainey, M. Purcell, *A. C. Bowden, *W. J. Colebatch, E. Dunstan, J. Forbes, H. B. Hiles, W. Munslow, W. Robertson, J. D. Whitehead, *J. Whitly, *H. Yeoman.

SECOND PROFESSIONAL EXAMINATION.

Messrs F. Moore, *W. J. Coffey, J. Dalrymple, H. Barker, P. Braw, W. T. Dunstan, *W. Harris, W. Jelbart, *J. T. Keall, *W. Nairn, *J. S. Nimmo, J. P. O'Reilly, †J. Warwick.

THIRD PROFESSIONAL EXAMINATION.

Messrs P. Donovan, T. Fleming, *W. Ludgate, F. W. Paulett, W. J. Boyd, J. E. Cockroft, F. W. Cundall, C. H. W. Cunningham, R. A. Edwards, G. Garden, W. Hepburn, *R. B. Littler, T. E. Nunan, E. Ryan, S. E. Sampson.

FINAL EXAMINATION.

Messrs T. H. Brown, E. Evans, H. Leyshon, J. H. Tranter, *R. R. Arthur, D. C. Barringham, J. Duff, T. G. Doyle, T. D. Hughes, T. Morland, J. L. Dixon, H. E. Audley Charles, W. P. Cushnahan, R. S. Garraway, †A. Gofton, G. H. Livesey, H. V. Mossman, J. A. M'Gregor, J. Pollock, *S. A. Winkup, C. Farrar, T. F. Hall, E. E. Stokes, J. Younghusband, H. O. Purves.

GLASGOW VETERINARY COLLEGE.

PASS LIST.

The following are the Pass Lists of this Institution for Session 1898-99.

FIRST PROFESSIONAL EXAMINATION.

Messrs A. V. Maynard, J. S. Woodrow, G. W. Weir, J. M'Farlane, N. H. M'Alister, *J. Wallace, †J. F. Craig.

SECOND PROFESSIONAL EXAMINATION.

Messrs D. Frew, D. M'Alinney, *F. P. Beck, J. Allan, C. Bell, J. Danskin, *A. L. Logan, †J. M'Cutcheon, †J. H. Lyons, *A. M'Dowch, *W. Ferguson, *A. Logan, J. H. M'Laren.

THIRD PROFESSIONAL EXAMINATION.

Messrs D. M'Hattie, *A. K. Murray, J. P. Sonaill, J. Baird.

FINAL EXAMINATION.

Messrs *W. W. Lang, J. J. Atkins, *P. M'Kinlay, W. Watson, J. Stevenson, A. F. Jackson, E. P. Jenkins.

NEW VETERINARY COLLEGE, EDINBURGH.

PASS LIST.

The following are the Pass Lists of this Institution for Session 1898-99.

FIRST PROFESSIONAL EXAMINATION.

Messrs C. W. Bourke, R. Hayes, R. Jones, A. B. Mathieson, H. Sleddon, T. Walker, A. Walker, *W. Hepburn, J. E. Smith.

SECOND PROFESSIONAL EXAMINATION.

Messrs W. Greaves, F. Moon, *L. Pitts, †M. Sowerbycoo, R. Scott, *A. A. Walker, T. Weedall, E. W. Morton, *H. Barrow, F. J. Dunning, W. A. Elder, H. B. Kauntze, †H. Kirby, J. Latta, H. H. Lord, Z. B. Rutherford, H. Sugden, *J. T. Willows, J. D. C. Ward, F. R. Sheppard.

THIRD PROFESSIONAL EXAMINATION.

Messrs E. Ashworth, W. G. Burndred, E. Finncane, H. E. Martin, *B. Runciman, *T. Runciman, A. Spreull, J. P. Dunphy.

FINAL EXAMINATION.

Messrs *W. Ogilvy, J. C. Blake, G. Barras, H. Dyson, *W. L. Gascoyne, D. M'Donald, A. M'Nae, H. Taylor, J. Paul, J. Evans, J. Fairclough.

PRINTED BY W. AND A. K. JOHNSTON, EDINBURGH AND LONDON.

THE

JOURNAL OF

COMPARATIVE PATHOLOGY

AND

THERAPEUTICS.

VOL. XII.—NO. 4. DECEMBER 30, 1899. PRICE 2s. 6d.

CANINE AND FELINE SURGERY.[1]

(Continued.)

By F. HOBDAY, F.R.C.V.S., Royal Veterinary College, London.

Operations on the Genital Organs.

Operations on the Prepuce and Penis. Tumours.—Tumours are frequently found inside the prepuce and around the base of the penis; they are usually very vascular, bleeding upon the slightest provocation. In stud dogs their presence is to be regarded with great suspicion, as one variety, at all events (sarcoma), is capable of being communicated to the bitch during copulation, the vagina of the infected bitch again being capable of infecting the penis of a healthy dog. The experiments of Smith and Washbourn[2] clearly demonstrate these facts.

Ordinary pedunculated tumours can be ligatured and readily removed with scissors or actual cautery, but the infective venereal tumours are exceedingly troublesome. If incompletely removed the remains of the growth increase very rapidly, and soon become larger than before. Smith and Washbourn obtained successful permanent results by snipping the mucous membrane around the base of the tumour and stripping it off with the attached growth from the underlying tissues, the wound in the mucous membrane being drawn together afterwards with fine silk.

Paraphimosis.—In cases of paraphimosis it is sometimes necessary, when all other means fail, to slit the extremity of the prepuce. This

[1] Copyright by the author.
[2] "Journal of Comparative Pathology and Therapeutics," Vol. XI., p. 41.

is done with a fine blunt-pointed bistoury, care being taken not to incise further than is absolutely necessary, on account of the risk of subsequent adhesion or stricture. Scarification of the penis may have to be resorted to in cases of extreme congestion. This is a very simple operation, and is done lightly in a longitudinal direction around the penis with a fine scalpel or small lancet, the wounds being afterwards covered with some antiseptic.

Castration.—This operation is performed in order to keep the animals from wandering; also in certain diseased conditions, such as orchitis and enlargement of the prostate gland; and in cats, in order to diminish the unpleasant odour possessed by the urine. Although it should be done under an anæsthetic, this is not always employed, as the operation is very simple, and completed within a few seconds. Before making the incisions the hair should be clipped or shaved off and an antiseptic used, particularly in the varieties of cats which have long hair; neglect of these precautions has been known to lead to septicæmia and death.[1] The dorsal position on the operating table is the most convenient. A cat, when no anæsthetic is used, may either be rolled up in an ordinary towel (care being taken not to cause suffocation), with the parts to be operated upon left

FIG. 68.
Showing method of holding cat for castration.

exposed, or held by an assistant, as shown in the photograph. An old-fashioned way used to be to put the animal head downwards in a topboot or the sleeve of an overcoat.

In the method illustrated above the cat is lifted up by the shoulders, the fore and hind limbs on each side being crossed over one another and grasped tightly. The first fingers are then crossed under the throat, and the thumbs are pressed firmly at the back of the head in such a way that the cat cannot get its mouth down or even sideways to use its teeth. The tail is pulled out of the way and the hind

[1] W. R. Clarke, "Veterinary Record," Vol. VIII., p. 449.

legs are held widely apart. The operator should never stand immediately behind, as the animal is apt to eject a stream of urine in that direction.

The operation is performed as follows: An incision is made over each testicle separately, the organ is withdrawn, and the cord is twisted several times and slowly scraped through. Another method commonly adopted is to employ traction on the cord until it gives way; with either of these methods the hæmorrhage is very slight.

In old dogs, those of large breeds, and those which have diseased conditions of the cord, more care must be used. For these cases an anæsthetic should always be administered, as the operation is necessarily to some extent prolonged. The testicle is exposed in the usual

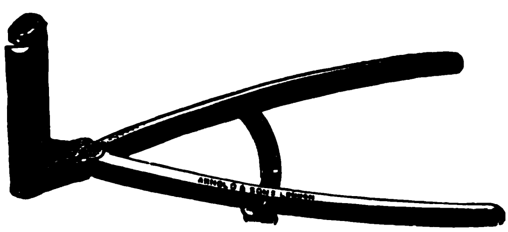


FIG. 69.
Torsion forceps.

way and removed either by slow scraping after twisting the cord several times, by excision after the application of an aseptic ligature, by an emasculator, by the clam and iron, or by torsion forceps and clam. Each method is good in its way, and the choice must be left to the discretion of the operator.

When aseptic precautions have been rigidly adopted the scrotal wound may be sutured and covered with iodoform or orthoform and collodion, the sutures being removed in four or five days. To pre-

FIG. 70.
Elizabethan collar.

vent the animal from licking the wound the device known as an Elizabethan collar, made of some stiff material such as wood, leather, or tin, is very useful.

If asepsis has not been properly carried out the best plan is not to suture but to treat the part as an open wound, antiseptics being freely applied two or three times a day. Exercise is always beneficial, and the prognosis given may in the majority of cases be favourable. The chief precautions to take are: In the dog, to guard against hæmorrhage either at the time or afterwards; and in the cat, to carefully clip off the hair before making the incisions, to avoid asphyxiating the animal when holding it, and to be careful not to excise the penis by mistake. When the latter is done death invariably ensues.

Castration of Cryptorchids.—Cryptorchids are not uncommonly met with in dogs and cats, particularly cases in which one testicle is hidden. On account of the small size of the inguinal canal, unless the hidden organs happen to be close at hand, the best method of reaching them is to perform laparotomy and remove them through the abdominal wound.

The necessity for operating upon one such case occurred during the present year, both testicles being situated in the abdomen.[1] Under a general anæsthetic the incision is made either in the flank, at the side of the penis, or in the median line about half an inch in front of the prepuce, under the usual aseptic precautions. The operator inserts his middle finger and searches in the lumbar and pelvic regions for the missing testicles, withdrawing each one in turn, and excising it after the application of a ligature. The abdominal wound is then treated as already described (*see* laparotomy).

Amputation of Prolapsed Vagina.—In cases of prolapse of the vagina it is customary to try various remedies, such as the application of a pessary and sutures, together with certain internal remedies, before resorting to amputation, the object being to get recovery without injuring the vaginal walls. When, however, all hope of permanent return has been given up the prolapsed parts have to be excised. The operation is not a difficult one, and rarely gives rise to bad sequelæ if performed properly and the animal is not very much exhausted.

The patient is secured on the operating table in the abdominal position, or may be held securely in the standing posture by an assistant. The parts, having been thoroughly cleansed with some antiseptic solution, are dried carefully with cotton-wool and painted with a five per cent. solution of cocaine (unless the patient is already under the influence of some general anæsthetic). Amputation is performed either by the clam and iron, the écraseur, or the ligature and knife, according to the will of the operator.

Judging from several experiences of each way the ligature seems to be the best if it can be used, the écraseur being the least preferable on account of the amount of laceration caused. In all cases care must be taken not to include the opening of the urethra in the part excised.

After-treatment consists in plugging the vagina with wadding, or syringing with solution of liq. ferri perchlor. and water until hæmorrhage has ceased, and afterwards using an antiseptic solution as long as may be considered necessary.

Gray obtained permanent success in one case by performing

[1] "Veterinary Record," Vol. XII., p. 298.

laparotomy, replacing the prolapsed part and attaching it to the abdominal wall with sutures.

Oöphorectomy and Ovariotomy.—This operation, commonly spoken of as "spaying," is performed for certain diseased conditions of the genital organs and also with the object of preventing pregnancy and œstrum. Its effect upon the latter is by no means absolutely certain, as upon several occasions we have observed signs of œstrum in bitches and cats whose ovaries have been wholly removed, the animals even copulating with the male.[1] Leeney has also observed the same.[2] The term "oöphorectomy" is applied when the ovaries are healthy, and the term "ovariotomy" when they are diseased.

Animals may be operated upon at any age, but from six to twelve months for the bitch, and from three to nine months for the cat, seem to be the most favourable. The method of operating is as follows:—

Having previously had the abdominal wall around the seat of incision carefully cleansed and shaved, a pad of antiseptic material is put over the part and the animal placed on the operating table to be anæsthetised; when unconscious the patient is turned over and fixed on its back with the limbs well spread apart. The antiseptic pad is removed, the skin being lightly scrubbed with ether and again washed with antiseptic lotion. A longitudinal incision of from about half-an-inch to an inch long is made through the skin and muscular tissue on or close to the median line just behind the umbilicus, all blood vessels being carefully taken up with artery forceps before the peritoneum is pierced. The latter is done with the point of a scalpel, the incision being completed with the aid of a director. At this stage a blunt probe or flexible catheter is inserted by an assistant into the vagina; this generally penetrates as far as the *os uteri*, occasionally passing into one of the cornua. The operator introduces the fore or middle finger of his right hand, or a blunt hook, into the abdomen, keeping it close to the abdominal wall and pushing the intestines on one side, the object being to find the probe which an assistant is moving cautiously about. Having found this it becomes an easy matter to follow up each horn in turn until the ovary is reached.

In young animals the latter may be simply scraped off with a blunt scalpel, but in older ones it is advisable to ligature above and below the ovary with aseptic catgut or silk before excising. In either case care must be taken to see that the whole of the ovary is removed, or the animal will still be liable to become pregnant,[1] thus defeating one of the main objects of the operation. The cut ends of the cornua are returned into the abdomen, the wound in the abdominal wall being treated as already described (*see* laparotomy).

The percentage of successful results is high[3] if antiseptic precautions are observed. The chief unfavourable sequelæ to be feared are those of collapse, peritonitis, descent of the bowels, hernia, and persistent disinclination to feed. The first and last mentioned have given us considerabie trouble in feline patients, several having refused to feed although apparently all right in every other particular, and

[1] "Veterinary Record," Vol. XII., p. 15.
[2] "Veterinary Journal," Vol. XXXI., p. 11.
[3] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 175; Vol. XI., p. 254. "Veterinary Record," Vol. XII., p. 14.

post-mortem examinations have given no clue as to the cause of death. Iodoform powder and other dressings which are at all poisonous should always be used very cautiously for wounds on small dogs and cats, and we have had good reason to suspect that iodoform dressings were sometimes at the root of the mischief. Peritonitis can be avoided by rigid attention to antiseptic precautions, and by putting the animals in a clean place after the operation. To avoid hernia and descent of the bowels the patient should be kept quiet, and not be allowed to jump from any height or go up steps for at least three weeks after the operation.

Hysterotomy.—In this operation, commonly known as "Cæsarean Section," the uterus is incised and the contents removed. The subject is prepared in the same way as for oöphorectomy, the abdomen being incised and the uterus exposed. The latter organ is then drawn to the edge of the wound or withdrawn altogether from the abdomen, being placed on a warm cloth which has been boiled or otherwise rendered aseptic. The uterus is incised in a longitudinal direction, the situation chosen being one as free from blood-vessels as possible, and the fœtus or fœtuses (with the placentæ) are removed. After their withdrawal the interior of the womb must be swabbed out with antiseptic solution, particularly near the wound. The edges of the latter are then drawn together by two or in some cases three rows of sutures; the first row consists of silkworm gut and is passed right through the wall of the uterus, the second and third are made of silk or fine catgut and are of Lembert's pattern, thus completely burying the first row and so lessening the risk of septic infection. When more than one fœtus is present the womb may have to be incised in several places, and this increases the danger. Before this is done an attempt should always be made to pass the fœtuses along towards the first wound and extract them in that way. The abdominal walls and skin are sutured and treated as in laparotomy. The chief sequelæ to be dreaded are collapse and peritonitis, and the percentage of successes is very low compared with those of hysterectomy. Successful cases have, however, been recorded, pregnancy afterwards taking place and successful delivery being effected without difficulty.[1]

Hysterectomy and Ovaro-hysterectomy.—By the term "hysterectomy" is meant the removal of the entire uterus, and the term "ovaro-hysterectomy" is employed when the ovaries also are included. The operation is occasionally performed for the same purpose as oöphorectomy. It may be necessary in some cases of dystokia, or where dystokia is to be feared, as when the female of a small breed has become pregnant by a male of some larger variety. The patient is prepared in the same manner as for oöphorectomy, the incision in the abdomen being of sufficient size to allow the gravid uterus (if this condition is present) to be withdrawn. Two catgut or boiled silk ligatures are placed above each ovary, and two others around the body of the uterus just below the junction of the two horns. The parts between are excised, and the uterus and contents lifted out of the abdomen, the ligatures effectually preventing any of the contents from escaping into the latter. The stump of the uterus is carefully disinfected and returned into the abdomen. It is not necessary to in

[1] Mathis, "Journal of Comparative Pathology and Therapeutics," Vol. II., p. 277.

any way fix the stump to the external wound. The external wound is sutured and treated exactly as already described (*see* laparotomy).

The prognosis of this operation, if the patient is not too poor or exhausted, is excellent,[1] recovery being very rapid.

As after oöphorectomy, we have known œstrum to occur and even copulation to take place when the two ovaries and the whole of the uterus as far as just above the junction of the horns with the body have been cleanly taken away.

Operations on the Limbs.

Operation for Overgrown or Ingrowing Nails.—In dogs that have insufficient exercise it is common to find the nails very long, the animal suffering a good deal of pain and becoming lame in consequence. The dew claws, in particular, if neglected, grow to considerable length and often curl round so that the points become embedded in the flesh. They are shortened by merely cutting a portion off with instruments similar in pattern to bone forceps or wire nippers. The

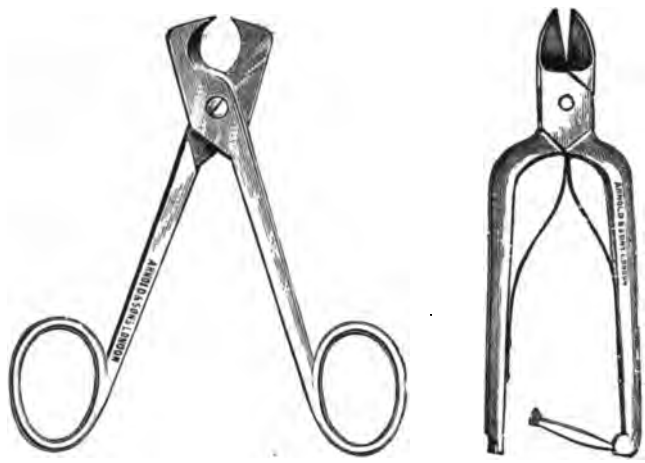


FIG. 71.
Two Patterns of Nail Forceps.

instruments should always be applied in a vertical direction, not transversely, as there is less danger of splitting the nail. The claws should not be cut too short or they will bleed and remain sore for several days; when cut to the sensitive structures the application of fomentations containing some sedative or antiseptic drug is beneficial.

Removal of Dew Claws.—In some dogs the dew claws are continually becoming injured and require to be amputated. Sometimes the nail has no bony attachment, being united to the limb merely by a piece of skin. In these cases, after removing the hair and thoroughly cleansing the part, the claw is snipped off with a strong pair of

[1] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 176; Vol., XI., p. 252. "Veterinary Record," Vol. XI., pp. 463 and 652.

scissors, and the edges of the skin united by sutures. When there is a distinct bony union the skin is drawn down towards the nail and incised by a circular sweep; it is then pushed back and the protruding bone removed as high up as possible. The skin is sutured and the wound treated antiseptically.

In the majority of cases a local anæsthetic is all that is necessary, and for securing on the operating table the abdominal position (*see* Fig. 9) is the most convenient.

Amputation.—For this operation a general anæsthetic should always be given. Wherever possible the parts around the site of incision are carefully shaved, cleansed, disinfected, and bandaged an hour or two before the animal is secured for the operation. The position in which the patient is placed must be arranged according to the discretion of the operator.

In cases where one leg is injured it is a good plan to secure the three sound legs with hobbles, and instruct an assistant to gently, but firmly, keep hold of the injured one above the seat of the accident until anæsthesia is complete. When this has taken place the bandage is removed and the injured leg placed on a cloth which has been boiled or otherwise rendered aseptic.

After having placed a tourniquet of tape or elastic above the seat of operation, the skin is pulled downwards as far as possible and incised with a sharp-pointed scalpel or long thin-bladed amputation knife. The incision may be either circular or flap shaped, the latter being the one which has given us the best results. The circular incision is made

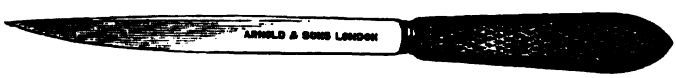


FIG. 72.
Amputation Knife (Liston's).

with one sweep of the knife all around the limb, the flap method being done by incising the skin in the form of a wedge. The skin is pushed back and the muscles are treated similarly, being dissected off the bone so as to expose the latter as high up as possible. The bone is then removed with a saw.

If the sharp-bladed amputation knife is used the point is thrust through the skin and muscles alternately on each side of the leg, and the flap made by two rapid downward incisions.

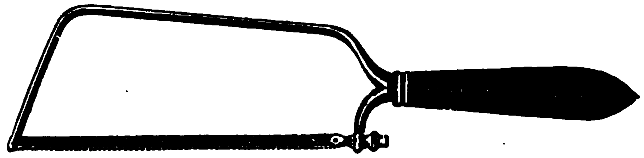


FIG. 73.
Amputation Saw.

The vessels are sought for and twisted or ligatured; the edges of the wound are drawn together with boiled silk or aseptic catgut, the muscles and skin being treated separately.

After-treatment consists in carefully keeping the parts clean by the aid of antiseptics and bandages, or, if the stump is too short for these to be put on, the wound may be covered with iodoform collodion. The stitches should be removed about the fourth or fifth day, or sooner if it is suspected that pus is present.

False legs consisting merely of a plain leather socket or a more elaborate arrangement, as shown in Fig. 74, can be fitted afterwards,

FIG. 74.[1]
Showing two Patterns of Artificial Limb.

but it is astonishing to see how soon an animal can reconcile itself to the loss of a limb and how well it soon learns to walk about on the remaining three. In one case which occurred last year a very valuable whippet's life was saved at the expense of the two fore-legs, which were becoming gangrenous owing to compound complicated fractures, the wounds being completely healed within ten days.[2] The animal

[1] This figure has already appeared in the "Veterinarian," Vol. LXVIII., p. 400.
[2] "Journal of Comparative Pathology and Therapeutics," Vol. X., p. 362.

soon learned to hop about like a kangaroo, and has since been used successfully several times as a stud dog.

Operations on the Tendons.

Tenotomy.—A contracted condition of one or more tendons in connection with a fore paw is occasionally met with, the paw being deformed and the animal lame in consequence. This can be remedied by tenotomy, performed at the most convenient and superficial place of whatever tendon is supposed to be contracted. The operation is not a difficult one and gives very satisfactory results. An anæsthetic is used, the parts are shaved, and strict attention paid to antiseptic precautions, the patient being secured on its side or back. An incision is made through the skin at the side of the tendon, and a blunt-pointed tenotome is introduced flatwise whilst the leg is flexed; the cutting edge is turned towards the tendon, the leg is straightened and the tendon cautiously cut through. Care must always be taken not to wound any of the blood vessels and not to cut through the skin at the other side or back of the tendon, on account of the trouble which is likely to ensue from excessive granulations. The wound is then sutured and covered with iodoform collodion and a bandage.

The most common situations for tenotomy are just above and behind the carpus and the under surface of the deformed toe.

Suture of Divided Tendon.—After severe injuries, especially wounds and cuts on the legs, some of the tendons are frequently found to be severed. Unless the divided ends are re-united the animal is apt to become a permanent cripple. The ends must be carefully sought for and brought into apposition, being first lightly scraped or roughened. They are then united by fine sutures of catgut or silkworm gut, the latter being the most suitable as they remain in position for years without becoming absorbed. The limb must be fixed so that no strain is put upon the tendon for some weeks until firm union has taken place, and antiseptic dressings are applied to the wound. Occasionally, although such cases must be comparatively rare, a ruptured tendon will be met with when there is no external wound of the skin. An instance of this was met with a short time ago, the patient being a fox terrier dog whose gastrocnemius tendon was found to be completely divided, without any history whatever of injury. The animal showed no sign of pain, but walked on its tarsus like a rabbit. Under chloroform and antiseptic precautions an incision was made through the skin, and the divided ends were sutured; after-treatment was the same as already advised above, and the result was a complete and permanent success.[1]

Dislocations and Fractures.

Dislocations.—A dislocation is distinguished from a fracture by the fact of the swelling occurring at a joint, the absence of crepitus, and, as a rule also, of pain during movement. The limb is also perceptibly shorter than the other. The most common dislocations met with are those of the elbow, stifle, shoulder, and toe joints. They are most frequently seen in young dogs and are most troublesome conditions to deal with on account of the tendency to relapse after reduction has been effected. The prospects of cure are much better

[1] "Veterinary Record," Vol. XII., p. 310.

if treatment is adopted immediately after the injury has occurred. The principles of treatment are as follows: Chloroform or some general anæsthetic is of service in severe cases because it relaxes the tissues and because after reduction it is easier to keep the parts in their proper places until external supports are affixed to keep them in position. The patient is placed in a lateral posture on the operating table, three legs being fixed and the injured one placed in the most convenient position for the application of traction. An assistant takes a firm hold above the dislocation (when the shoulder joint is affected a broad bandage or handkerchief is passed under the axilla and held from either side), the operator then grips the limb just below the injury with one hand and employs steady traction in whichever direction he deems necessary to replace the affected parts in their normal situation; at the same time with the fingers and thumb of the other hand he endeavours to adjust the joint. In old standing cases a successful result is often impossible but in recent cases reduction can generally be effected. The most difficult task is to retain the parts in position, and the attempt to do this frequently ends in failure. Bandages and strappings of different kinds covered with gum, plaster of Paris, starch, some preparations of pitch, etc., are most commonly used, but the difficulty is to get them to fit closely without causing gangrene, and especially with the elbow joint. Poroplastic felt, cardboard, brown paper moulded to the limb, are each sometimes used with success, but with each the prognosis as to a complete cure should always be guarded.

In one very troublesome elbow dislocation which occurred this year in a toy Manchester terrier, we attained a successful result so far as the dislocation was concerned by wiring the radius and ulna into place, but the patient never satisfactorily regained full use of the leg. Under chloroform and strict antiseptic precautions holes were made through the radius and ulna with a fine gimlet. Fine wire was passed through these and the skin wound treated in the ordinary way.[1]

Fractures are termed *simple* when there is no external wound, *compound* when the skin is broken, *comminuted* when the bone is broken into several fragments, and *complicated* when there is serious injury to some artery or the structures in the vicinity. The term "greenstick" is applied to a fracture such as frequently occurs in puppies or kittens in which the bone is bent and only partially fractured. In a *simple* fracture reduction is effected and the ends brought into apposition by grasping the limb firmly with one hand above the seat of injury and placing the lower portion into position with the other hand, the animal being held firmly by an assistant or placed under the influence of a general anæsthetic. The divided ends are then maintained in place by the application of bandages and splints, the latter being made of wood, metal, leather, cardboard or poroplastic felt. In order to prevent chafing of the skin the limb is first covered with lint, wadding, or a bandage, especial attention being paid to all bony prominences; the splints (also carefully protected) are then laid on in such a way as to keep the limb rigid. One or two narrow bandages which have been smeared with solution of gum, glue, pitch, starch or plaster of Paris, are then neatly wound

[1] "Veterinary Record," Vol. XII., p. 344.

round the whole. Gum is particularly valuable on account of the objection the animal shows to attempting to bite it off. Solutions of those substances should be made thick, care being taken that the external bandage dries and is hard before the patient is allowed to put the limb to the ground. It is always a wise precaution, if the severity of the case needs a tight bandage, to include the foot, as if this organ is left free and circulation is impeded above it the result is that the toes become swollen and, if not attended to, gangrenous.

With a compound fracture, particularly in the cat, much difficulty is often experienced; in many cases the quickest way to recovery is to amputate the limb above the seat of injury. When an attempt is made to treat it otherwise, the wound is carefully cleansed with an antiseptic and dried thoroughly, a bandage and splints being applied as for a simple fracture, but a window being left in it in order that the wound may be dressed; this "window" can be formed by placing a pill box lid over the wound when bandaging and afterwards removing it by cutting out the parts above with scissors. Particular care must be taken to dress the wound frequently, and to see that none of the discharge runs downwards underneath the bandage.

FIG. 75.
Photo showing characteristic attitude when both fore legs are broken.

Fractures of the ribs are treated by placing a broad bandage around the chest and abdomen as tightly as possible without causing inconvenience to the patient.

Fractures of the jaw necessitate a special splint cut or moulded to the required shape, and kept in position by tape or a wire muzzle,[1] the patient being fed artificially by mouth or rectum on liquid nourishment.

Fractures of the tail are treated in a similar manner to those of the limbs, particular care being taken that the bandage is not put on too tight.

Fractures in the region of the shoulder, pelvis, and hip, when too high up for bandaging, are treated by the application of a "charge" or plaster, consisting of some such mixture as resin, one part; Venice turpentine, three parts; Burgundy pitch, five parts, and put on with a spatula whilst hot. The layers may or may not be interspersed with tow cut up very fine. The exterior should

[1] Hodgkins, "Veterinarian," Vol. LXIX., p. 902.

always be covered with a piece of calico or some material to prevent it from sticking to the ground when the animal lies down.

The time for which a permanent bandage requires to remain in position varies from three to six weeks. The patient should be kept as quiet as possible, on no account being allowed to run up and down steps or to jump from any height. The principal untoward sequelæ to be feared are:—

1. That the limb may not be straight afterwards. This frequently happens when the bandage is not sufficiently stiff and the patient attempts to bear weight on it too soon.

2. That union may not take place, or that the union may be a fibrous instead of a bony one. The latter condition gives rise to what is termed a false joint, and not infrequently happens after comminuted fractures or when the injury has not been attended to during the first few days. The internal administration of phosphate of lime in the form of Syr. Phosphat. Co. is beneficial.

3. Gangrene, owing to severe injury to the principal vessels or to the bandage having been put on too tightly or insufficiently padded. A fœtid, sickly smell from the bandaged leg must always give rise to suspicion of this, and the bandage should at once be removed.

4. Septicæmia, especially in compound fractures.

Operations upon the Tail.

Amputation.—This is performed in full-grown dogs in a similar manner to that described for amputation of a limb, the flap method giving the most successful results. When performed at the root of the tail healing usually takes place without much trouble, but when performed near the extremity the healing process is apt to be very slow, and much retarded by the action of the animal in licking or biting the parts, or by banging the tail against the walls, floor, etc. In amputating near the end, it is better to take the end of the tail off at a joint rather than to go through one of the coccygeal vertebræ.

In order to prevent undue irritation by the tail being banged against the external surroundings, the patient should be tied to the centre of a rope placed across the middle of a loose-box or large room, sufficient length of rope being allowed for the animal to lie down without its being able to reach the hind quarters. Another plan adopted is to place a strap round the loins or ribs and another round the neck, a stick being firmly fixed between the two in such a way that the body cannot be bent; the tail itself may be ensheathed in a case of leather or tin. The Elizabethan collar (Fig. 70) is also useful here.

Very often, especially in large breeds, such as boarhounds and St. Bernards, all methods adopted to preserve the tail are unavailing, amputation at the root having to be resorted to before healing can be effected.

In puppies the operation is a very simple one, the tail merely being snipped off with a pair of scissors when they are a few days old.

OBSERVATIONS ON THE MORBID ANATOMY OF TUBERCULOSIS IN CHILDHOOD.[1]

WITH SPECIAL REFERENCE TO THE PRIMARY CHANNELS OF INFECTION.

By GEORGE F. STILL, M.A., M.D., M.R.C.P., Assistant-Physician for Diseases of Children, King's College Hospital; Assistant-Physician to the Hospital for Sick Children, Great Ormond Street.

THE prophylaxis of tuberculosis is probably of greater importance in childhood than at any other period of life, inasmuch as it is at this age that the disease is most prevalent and most fatal. In order that prophylaxis may be satisfactorily carried out, it is most desirable that it should be ascertained as far as possible what are the most frequent channels of infection. With this object in view I have ventured to put on record here some observations made in the *post-mortem* room while I was Pathologist at the Hospital for Sick Children, Great Ormond Street.

These observations rest entirely on the results of *post-mortem* examination, and it must be pointed out that it is only from statistics made in this way that any accurate knowledge of the incidence of tuberculosis at particular ages and on particular organs can be obtained. Anyone who has had experience of *post-mortem* examinations knows only too well that tuberculosis is by no means always easy to diagnose clinically in children; even a very extensive tuberculosis may not be recognised as such during life, while many a pulmonary or abdominal condition thought clinically to be tuberculous is found *post-mortem* to be non-tuberculous, and this with no blame whatever to the clinician, for such error is common enough where the case has been examined carefully during life by several skilled observers.

It is evident therefore that any statistics which include cases not verified by necropsy are of little or no scientific value in this connection. Large figures may be obtained by making use of the Registrar-General's returns, but as these are necessarily based on death certificates given in the vast majority of cases without *post-mortem* examination, they are of very little use in a scientific investigation, and may lead to entirely erroneous conclusions.

Age-Incidence in Children.

With these preliminary remarks I pass to the consideration of the incidence of tuberculosis during the first twelve years of life, and it is of some importance that attention should be drawn to this, for the great prevalence of the disease during the period of infancy is a point of particular interest in the question of the source of infection.

The total number of cases of tuberculosis met with in 769 consecutive necropsies on children under twelve years of age was 269; so that in more than one-third of the total number of cases tuberculous lesions were found. Death was not due in every case to tuberculosis: in 43

[1] Reprinted from the "British Medical Journal," 19th August 1899.

out of the 269 cases death was due to some entirely different cause, such as diphtheria, heart disease, etc.

In the chart which is here drawn up, the incidence at the various ages is shown, and it will be seen that tuberculosis is far more frequent during the second year of life than at any other time.

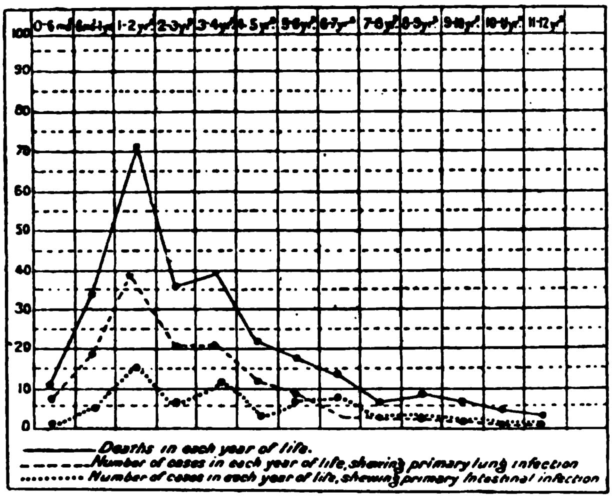


Chart showing relative frequency of tuberculosis in the first twelve years of life, and also of infection through the lung and through the intestine.

The figures given show that 117 out of the 269 cases occurred within the age of two years, that is no less than 43·4 per cent. of the whole number of cases of tuberculosis occurred within the first two years of life, and it will be seen that 56·5 per cent. occurred within the age of three.

The Mode of Infection.

It is evident that the main incidence of tuberculosis corresponds more or less exactly with the period at which milk forms, or should form, the chief article of diet. The suggestion that milk contaminated with the tubercle bacillus is the cause of this frequency follows as a matter of course. In a report on tuberculosis issued by the Council of the British Medical Association (18th January 1899), the following statement is made: "The mortality from tuberculosis in early childhood is not decreasing as it is at other ages in the United Kingdom, and the opinion that this great prevalence of the disease in infancy and childhood is due to infection through the alimentary canal by milk from tuberculous cows appears to be well founded."

At first sight such a view appears extremely probable. It has been proved beyond dispute by Professor Delépine and others that the milk supplied even to our large towns frequently contains tubercle bacilli, and it has been pointed out by Professor Sims Woodhead that the intestines and mesenteric glands are very commonly found to be affected with tubercle in young children. But further inquiry is needed before any conclusions can be drawn from these premises.

The frequency of tuberculous lesions of the intestine and mesenteric

glands in infancy and childhood is indeed a well-ascertained fact, but the mere frequency of its occurrence is no evidence of its being the most common source of infection. As a matter of fact pulmonary lesions would seem to be considerably commoner than intestinal; in the series of cases mentioned the intestine or peritoneum was found to be affected in 141 cases, while pulmonary tuberculosis was present in 210.

Moreover, in estimating the significance of such frequency it must be remembered that one of the striking features of tuberculosis in childhood is its tendency to generalisation; it tends to affect almost every organ in the body, and it is therefore often a matter of extreme difficulty to determine which was the primary channel of infection.

Further, there is a special reason for the frequency of intestinal lesions as a secondary phenomenon in the tuberculosis of childhood; namely, that all young children, and many older children, swallow all their expectoration, and consequently, with a primary infection of the lung, tubercle bacilli are constantly being swallowed in large numbers, far larger probably than are ever likely to be swallowed in the worst milk, so that secondary infection of the intestine is extremely likely to occur.

The frequency, therefore, of tuberculous lesions in the intestine or in the mesenteric glands is only what might be expected, and cannot be accepted as evidence that these structures form the primary channel of infection.

The difficulty of determining the primary channel in the tuberculosis of childhood is very great, for the reason already mentioned—namely, the tendency to rapid generalisation of the process; there is, however, one feature of the disease at this age which to some extent diminishes the difficulty; the lymphatic glands in childhood form such a delicate index of the extent and the duration of the tuberculous infection in the organs to which they correspond, that it is possible in many cases, from a careful consideration of the glands, to determine, with at least a high degree of probability, the primary source of the infection.

The Sequence of Infection.

In the observations recorded here the greatest weight has, therefore, been attached to the condition of the lymphatic glands, and it will be necessary to point out briefly the grounds on which I have based my conclusions as to the sequence of infection in these 269 cases of tuberculosis.

The extent and character of the tuberculous process in the lymphatic glands is taken *ceteris paribus* as an index of the duration of the infection in the organs to which these glands correspond—for instance, the presence in a given case of much enlarged, almost dry caseous, glands in the mediastinum, while the mesenteric glands showed only small scattered foci of greyish-yellow tubercle, is taken to prove *ceteris paribus* that the infection through the lung was of older standing, and therefore the primary lesion. Further, the condition of the lymphatic glands is of more importance in determining the duration of the infection than the condition of the corresponding organs; for example, in a case in which there is no demonstrable lesion in the intestine, while the lungs show much, but not advanced, tubercle, the presence of a large, dry, caseous, or calcareous gland in the mesentery,

contrasted with only greyish-yellow areas of tubercle in the mediastinal glands, would show that the infection through the intestine had been the primary lesion, in spite of the much more obvious lesion in the lung.

Lastly, the sequence of clinical symptoms is of little or no value, except, perhaps, as confirmatory evidence; for extensive pulmonary or intestinal lesions are often present without producing any special symptoms, and the first symptoms to appear are not always those due to the primary lesion; thus in a primarily intestinal case the secondary pulmonary infection may be the first to produce symptoms.

Glandular Infection.

In some cases, especially in the more chronic ones, the lymphatic glands are so extensively involved in many parts of the body that it is quite impossible to say which were first affected; thus it was quite impossible to determine the primary source of infection in 46 out of 269 cases.

It must be pointed out that in the statistics given here tuberculous infection of the mediastinal glands has been assumed to occur through the lung, while the mesenteric glands have been assumed to be infected through the intestine. It is quite certain that such infection of glands may occur without any demonstrable lesion in the lung or intestine; this has been proved experimentally in the pig in the case of the intestine by giving tuberculous material in the food; and in children, even with the most careful search, I have several times failed to find any naked-eye lesion of these organs when the corresponding glands were nevertheless quite caseous. But though such cases occur they are quite exceptional. In the 269 cases of tuberculosis only 9 showed affection of the mesenteric glands without naked-eye lesion of the intestine or peritoneum, and 10 showed affection of the mediastinal glands without naked-eye lesion of the lung or pleura. In the light, therefore, of the experimental evidence, it seems almost certain that in the few cases in which no lesion of lung or intestine is found, infection of the corresponding glands has occurred by the bacillus entering through the lung or intestine without producing any lesion, or rather any lesion which can be appreciated without microscopic examination. It has been suggested that in children in a certain number of cases the mediastinal glands become infected, as apparently they may in the pig, by direct extension downwards from the cervical glands. I have made special investigation of this point, and have come to the conclusion that such a method of infection, if it ever occur in the child, must be extremely rare. I have seen one or two cases where it seemed just possible, I have seen none in which it was certain.

Even where there is a considerable caseation in the glands at the upper part of the neck, those which correspond to the fauces or those which correspond to the ear, it is usually found that lower down they become less and less affected, until just above the clavicle there may be little or no affection, while below the level of the first rib, especially on the right side, there is often an enormously enlarged completely caseous gland or group of glands lying close to the trachea. Now, to suppose that the tuberculous infection after gradually diminishing downwards should for some unexplained reason "jump" completely several glands in the chain and produce more extensive caseation in

the mediastinal glands than at any part of its course in the neck, is improbable but not impossible; but when in addition to this it is quite certain from examination of a large number of cases that these tracheal glands are some of the earliest and most severely affected of the mediastinal glands in cases of pulmonary tubercle, even where the pulmonary lesion is very slight, and when it is pointed out that some degree of pulmonary tuberculosis is almost always found as part of the generalised tuberculosis of which the affection of the cervical glands is a part, it becomes exceedingly improbable that the tracheal glands should have been infected in any other way than through the usual source, namely, the lungs.

There is, moreover, another strong argument which might be advanced against such direct extension from the cervical glands. It has been shown by Dr F. E. Batten, in a most interesting paper on the Relative Frequency of Tuberculous Infection of the Lymphatic Glands in Children,[1] that of the glands in the mediastinum those on the right side are much more frequently and extensively affected than those on the left. My own figures fully corroborate this: in 145 cases it was specially noticed that the glandular infection in the mediastinum was more advanced on one side than on the other; in 113 of these cases the glands on the right side were the more affected, while in only 32 was the affection greater on the left side; moreover, in 23 cases in which perforation of a bronchus by one of the caseous mediastinal glands had occurred, in 21 it was on the right side, in only 2 on the left.

If, therefore, it be common for the mediastinal glands to be infected by direct extension from the neck, it should be found that there is a correspondingly large predominence of affection of cervical glands on the right side of the neck. Rough statistics of operations for enlarged cervical glands thought to be tuberculous have been collected for me very kindly by my friend Dr Rowland, and they show no such predominence even in these the most advanced cases, which are just those in which the direct extension might be expected to take place. Of 100 cases in which one side was chiefly affected, 51 were on the right side, 49 were on the left—in other words, the two sides of the neck were almost equally affected. It has been suggested, further, that occasionally the mediastinal glands become infected by extension from the retroperitoneal glands. My own experience, so far as it goes, affords no confirmation whatever of this. There are certain glands in the anterior mediastinum, just behind the ensiform cartilage, which are almost invariably affected in cases of tuberculous peritonitis, but I have found no evidence of any extension from these or from the retroperitoneal glands to the tracheo-bronchial glands.

It will be seen, therefore, that, so far as my own observations go, it seems extremely unlikely that the tracheo-bronchial glands are infected in any other way than through the lungs, except in very rare instances, some of which may be included in the cases which I have grouped together below as "uncertain," and I may say that I have been careful to separate all such doubtful cases, as, by grouping together only those in which the source seemed certain, or fairly certain, a more accurate conclusion was likely to be obtained.

[1] "St. Bartholomew's Hospital Reports," Vol. XXXI.

Channels of Infection.

As far as could be ascertained, in the 269 cases the channels of infection were as follows:—

Lung	105
Probably lung	33
Intestine	53
Probably intestine	10
Ear	9
Probably ear	6
Bones or joints	5
(?) Fauces	2
Uncertain	46

It will be seen that while the lung appeared to be the primary channel of infection in 138 cases, the intestine was thought to be so only in 63. These figures, however, include children of all ages up to twelve years. It is convenient to consider also the incidence at various ages; this has been already shown in the chart given on p. 293, but may be more accurately understood from the following table:—

Age.	*No. of Cases.*	*Primary Channel of Infection.*		
		Lung.	*Abdomen.*	*Ear.*
0-6 months	11	7	0	3
6-12 „	34	18	5	4
1-2 years	72	38	15	6
2-3 „	35	20	6	1
3-4 „	39	20	11	1
4-5 „	23	12	2	0
5-6 „	18	9	7	0
6-7 „	13	4	7	0
7-8 „	6	3	3	0
8-9 „	7	3	3	0
9-10 „	6	2	2	0
10-11 „	3	1	1	0
11-12 „	2	1	0	0

It would appear from these statistics that invasion through the lung is much commoner than through the intestine, both in infancy and in early childhood, while after the age of five years the chances of infection through the lung or through the intestine become about equal.

An interesting fact which appears from the above figures may be mentioned in passing, namely, that in 15 out of 269 cases—that is, in about 7 per cent. of cases of tuberculosis in childhood—the primary source of infection was the ear; and of these 15 cases, no fewer than 13 occurred within the first two years of life. No case of primary tuberculous disease of the ear was observed after the age of five years.

This frequency of infection through the ear in infancy is mentioned here because it seems probable that this channel of infection resembles that of the lung in being really a respiratory infection—that is, by inhalation—the infection passing up the Eustachian tube, and therefore in any consideration of the prophylaxis of tuberculosis these cases should be grouped with those of infection through the respiratory passages.

There is one class of cases which afford almost indisputable evidence of the method of infection in each individual case; I mean those in which death has been caused by some non-tuberculous disease, and *post-mortem* a single gland or group of glands shows an old dry caseous focus or just-commencing tubercle, and perhaps the organs to which these glands correspond show similar evidence of past or just-commencing tubercle.

In these cases, as the disease has been arrested at an early stage or has not yet progressed beyond its initial stage, generalisation has not taken place or is only just beginning, so that it is possible to determine with almost absolute accuracy the primary channel of infection. As already mentioned, 43 out of the 269 cases were of this character, and, although they are included in the above statistics, consideration of them separately is of great importance, for they afford, I think, conclusive evidence of the much greater frequency in childhood of infection through the lung than by any other channel.

In the 43 cases which died of diphtheria, heart disease, etc., the evidence as to the primary focus of infection was as follows:—

Lung	26
Intestine	16
Ear	1

These figures, it will be seen, strongly confirm the statistics given above, and leave, I think, no doubt that infection through the lung is far commoner than infection through the intestine in childhood.

The Frequency of Invasion through the Lung.

The special frequency of tuberculosis in infancy and in early childhood seems, therefore, so far as these observations go, not to be due to the milk diet to which it has been attributed, though there can, I think, be little doubt that this is responsible for a certain proportion of cases of tuberculosis at this age, about 17 per cent. of the cases during the first three years of life being intestinal in origin. Possibly the boiling of almost all the milk which is given at this age accounts for the much lower percentage of primary intestinal tuberculosis in infancy than during the later years of childhood, when milk is more likely to be given unboiled. It is of considerable importance, from the practical point of view, that this frequency of invasion through the lung should be recognised. Much has been said and written recently of the dangers of infection from the milk supply, and there has been a tendency to assume that this was the usual mode of infection in early childhood. We cannot be too careful in our precautions against tuberculous milk, but the above observations tend to show that food is not the only, nor even the chief source of, tuberculous

infection, and emphasise the extreme importance of purity of air for infants and young children.

It is probable that much of the tuberculosis of childhood is a direct result of the terrible overcrowding of the poorer population in our large towns. So long as whole families, and often large families, have to live night and day in one ill-ventilated room, and among them, too often, one or more are already infected with tubercle, and ready, in turn, to infect others, it is not to be wondered at that primary infection through the lung is so common in infants and young children. It seems likely that the special liability to this method of infection during the earlier years of childhood is directly related to the special inability at this age to escape from the foul atmosphere of "home" even for a few hours in each day, and as the child grows older and passes more of its time even in the comparatively pure air and the wider and more cleanly streets, or in the rather better ventilated schoolroom, the risk of pulmonary infection becomes by so much the less.

The above remarks apply of course mainly to the poor, inasmuch as all the observations recorded above were made on hospital patients; but the principle applies to all classes alike. Fresh air is absolutely essential to the well-being of children, and badly-ventilated rooms and undue confinement indoors, especially where there is already tuberculous infection in the house, constitute a very real danger to children, and particularly to children predisposed by heredity to tuberculous infection. For such children indeed, where circumstances render it possible, residence in the pure atmosphere of a dry, elevated country or seaside district, with an almost open-air existence during the first six or seven years of life, may be the way of escape from an early death from tuberculosis; and where such prophylaxis is impossible, abundance of open air in the parks and in the suburbs of our large towns, and such country air as can be obtained from time to time, may do much to reduce the risk of tuberculous infection through the lungs in the town-bred child.

Conclusions.

The conclusions which may, I think, be drawn from the above observations are as follows:—

1. The commonest channel of infection with tuberculosis in childhood is through the lung.
2. Infection through the intestine is less common in infancy than in later childhood.
3. Milk therefore is not the usual source of tuberculosis in infancy, perhaps owing to the precautions taken in boiling, sterilising, etc.
4. Inhalation is much the commonest mode of infection in the tuberculosis of childhood and especially in infancy.
5. The overcrowding of the poorer population in the large towns is probably responsible for much of the tuberculosis of childhood, and prophylaxis must be directed to the prevention of this overcrowding, the improvement of ventilation, and the inculcation of the extreme importance of fresh air during the earliest years of life.

PERSONAL EXPERIENCES OF OSTEO-POROSIS.

By HAROLD B. ELLIOT, M.R.C.V.S., Hilo, Island of Hawaii, H.I.

General Remarks.—The name osteo-porosis has been generally accepted as the designation of this strange and mysterious malady, which, although not infrequent in certain localities in the more civilised countries of the world, continues to baffle the efforts of scientists to discover its origin, and whose etiology and morbid processes are to-day as little understood as when Varnell first recognised the disease forty years ago.

Current English veterinary literature contains scanty reference to osteo-porosis, a fact which infers the rarity of its occurence in Great Britain. It is unfortunate that the bibliography of the disease is so limited, for further details are urgently needed to throw light upon the questions of climatology, geological formations, and dietetic conditions connected with its origin, and, above all, to dispel the doubts of its supposedly non-contagious, harmless nature which must lurk in the mind of every practitioner whose experience of the disease is extensive.

In certain localities of North America the disease is of frequent occurence; it is also occasionally recorded in European countries, and is said to be prevalent in Australia, particularly affecting coast lands (Kendall).

My experience leads me to believe that it is peculiar to solipeds, and that those diseases which have been described in cattle and sheep by the name of osteo-porosis are of a different nature, both in regard to their origin and pathological lesions.

Among the laity the disease is commonly known as "big head," "swelled head," or "lumpy jaw," and it is often confused by them with actinomycosis.

Etiology.—Each succeeding author who has dealt with the etiological aspect of the disease appears to have done so from a purely dietetic point of view, being probably induced to assume that position by Varnell's essay upon an outbreak of the disease, and, perhaps, also by the opinions expressed by Williams in his writings.

The former writer is responsible for the theory of a deficiency of lime salts in the food, whilst my learned preceptor sums up his remarks by prophesying that, "it will yet be discovered that the disease is due to the absence of some essential ingredient of the food, or its presence in such small quantities as to be insufficient for the necessities of the animal; or the presence of some other constituent of the food in such superabundance as to destroy the perfect composition of the ailment as a whole, and thus render it unfit for assimilation by, or so change it as to cause it even to become an irritant to, the osseous system."[1]

In the district of the Island of Hawaii in which the larger part of my practice is situated osteo-porosis is a very common disease, and claims as an annual tribute at least one hundred victims. Having nearly two thousand head of horses and mules under my personal supervision, I have enjoyed exceptional facilities for studying the disease from its

[1] "Principle and Practise of Veterinary Surgery."

earliest manifestation until recovery or death has caused a cessation of the morbid processes. The result of my clinical observations has convinced me that the theory of the dietetic origin of osteo-porosis is erroneous and founded upon mistaken conception of the pathology of the disease, and my opinion is that it is primarily and wholly one of locality, in other words, a climatic disease.

Only a very intimate knowledge of the varied conditions in which this disease originates, and of the many phases it assumes, can form the basis of a theoretical etiology which the next comer will not be able to overturn by his personal experiences of a single case.

Whether or not osteo-porosis is due to the now universal microbe, or closely akin to rheumatism (Robinson), or due to superfluities or deficiences of food elements, it is certain that some predisposing circumstances play a powerful part as causal factors, and none more so than those of a climatic nature. A peculiar combination of atmospherical conditions appears to be absolutely necessary either, (*a*) to foster the development of the etiological germ, or (*b*) to produce those changes in the chemical metabolism of the animal system which give rise to the characteristic symtoms. And these conditions appear to be associated, as we will see, rather with moisture than with heat or cold, or alternations of temperature.

The Island of Hawaii, in the Hawaiian or Sandwich Group, is the largest island of the group. The temperature at sea level rarely exceeds 85° or falls below 65°. District O. of this island is remarkable for its humidity, having an annual rainfall of one hundred and fifty inches. The other districts of the island are dry, and are rarely favoured with rain. The difference is due to the relation of the huge volcanic masses known as Mauna Kea and Loa to the prevailing winds. The boundaries of O. correspond exactly with the climatic conditions; a mile or two on either side conveys the traveller from fields sodden with moisture and covered with verdure to a land that is arid and parched.

In District O. the disease is remarkably prevalent, but I have neither seen nor heard of a case originating in the dry districts. Moreover removal of affected animals to the latter divisions of the island is followed by immediate improvement and ultimate recovery, a termination which never takes place otherwise.

Altitude and temperature do not appear to affect the course of the disease. In my district cases are seen both at sea level and on elevated lands where the thermometer occasionally registers freezing point.

Owing to lack of nutritious forage there are no breeding establishments in the rainy district, and of the few foals which are born nearly all succumb to the disease before attaining maturity.

The geoglogical formation of the island is similar throughout its whole extent, and is purely volcanic, several active craters being still in existence.

The food supplies of the different districts are obtained from the same source, and consist of American hay, oats, bran, and barley ; the only native foods being grasses and the leaves of the sugar cane. Some animals are fed entirely on a dry diet; others receive varying quantities of green forage. In the drier districts green forage is more universally given, but as so many animals, both in the dry and wet districts, live under exactly similar conditions as regards food, I feel

justified in stating that the factor of diet is a subordinate one in the causation of this disease. If errors in diet or superfluity or insufficiency of essential ingredients of the food bore any relation to the etiology of this disease, then, the dietetic conditions being the same, we would expect to find an occasional case outside of the limits of District O., but this is not so. And it must also be pointed out that the rapid recovery which ensues upon removal from the osteo-porosis districts is not accompanied by any essential difference in the nature of the food. Also, within the boundaries to which the disease is restricted, animals will contract it under any circumstances of diet, from the best quality of oats down to a diet of crushed lava rocks. The well fed, rarely used, imported horse of the rich planter and the poverty stricken, hide bound scrub of the Kanaka are equally the victims of this disease. To quote Williams against Williams, "animals of every class, *no matter how treated* are liable." In the dry districts the converse of this proposition is true ; no animal, no matter how treated, is liable. Usually dietetic diseases appear in a familiar guise of occurence and environment, and their cause is thus easily recognised, but osteo-porosis seems to be regulated by only one external predisponent to disease, viz. climate.

The water supplies in Hawaii are obtained from running streams and springs. Analysis reveals a deficiency of mineral salts. The water of the drier districts is similar in composition to that of District O. Stable buildings, with the accompanying details of light, ventilation, drainage, and cleanliness, bear the same relation to this disease that they do to others. Cases occur in every variety of stable.

I have noticed a predisposition towards this disease in animals whose work is of a light, intermittent nature, and who spend the greater part of their time idly in the stable and pastures. But many of my patients have been hardly wrought mules who have toiled many years *in duro servitudine.* Neither vigorous youth nor decrepit old age grant immunity, although young animals are more subject than those of advanced years. It may also be said that neither sex nor temperament appears to exert any influence. Horses contract the disease more readily than mules, but this is a physical characteristic noticed in connection with other diseases. Native horses exhibit an equal liability with those imported from other countries.

Small animals possess greater susceptibility than larger ones, but they are less acutely affected, and the disease in them often takes a very mild and lingering course. I have had two Shetland ponies under my observation for nearly four years. During that time they have fulfilled their light duties admirably, and are in excellent condition.

I am not aware that other internal diseases cause a special predisposition towards osteo-porosis. It frequently, however, follows wounds of the extremities, of the eye, mouth, and foot ; and this is particularly noted in those establishments in which the disease is endemic. But osteo-porosis is so indefinite in incubation, and so difficult to recognise in the earlier stages, that the relationship of the wounds to the disease is not an easy matter to estimate. I have seen it supervene on such operations as firing and neurotomy.

Several of my cases have appeared shortly after wounds of the feet, and the following injuries have been noted in the history of

other cases: lacerations of the eye-ball (three cases), of the abdominal muscles, of the scapular muscles, "rope burn," wound in hock, "broken knees," and injury to the mouth. In many instances, however, no history of injury can be found (excepting abrasions caused by harness or saddle, an injury which nearly all the animals in this moist, warm climate are subject to).

We have seen that whilst the animals of the various districts are exposed to very much the same vicissitudes of life, and enjoy a similar fortune in the matter of food, work, housing, and other necessities of their existence, those whose ill-luck it is to dwell in the humid parts of the island have many chances of contracting osteo-porosis which their more pleasantly situated brethren escape. But, even in District O., the disease presents a marked preference for certain stables in which it has been endemic for some years. The two stables of one plantation close to the town of Hilo have proved hotbeds of the disease. There are at this time sixteen cases of osteo-porosis among their animals, and great loss has been suffered for several years past. The neighbouring plantation, on the other hand, is almost exempt from its sad havoc, only a rare case occuring from time to time. The class of animals used, the nature of their daily labour, and their treatment in and out of the stable, is identical in every respect. In the stable of a large transportation company, who employ two hundred head of stock, I have never seen a single case of this disease, in spite of the fact that their animals do every kind of work, and the feeding has been changed over and over again.

In the description by Varnell of the outbreak upon a farm the same circumstance is noticed; the disease attacked one stable upon the farm but spared another. Only one subdivision of the many diseases which affect animal-kind manifests itself under these varied circumstances, and I am of the opinion that a more enlightened and precise knowledge of the pathological changes of osteo-porosis will reveal to us that it is a specific disease due to the invasion of the system by pathogenic micro-organisms. To me it is a strange fact that the arguments in favour of the specific nature of this disease have failed to impress practitioners whose daily work has brought them into close contact with the disease. The first stages of osteo-porosis closely simulate the incubative period of microbic affection; it frequently follows accidental injuries and operative wounds; it is endemic in certain stables and pastures without apparent cause; many circumstances support the belief of the laity regarding its contagious nature; the pathological lesions are not merely local but are generalised throughout the system; and the occurrence of the disease is practically uninfluenced by differences of diet, labour, stable management, hygienic surroundings, age, sex, and temperament. Only bacterial pathology affords us analogies likewise independent of these extraneous circumstances. Tetanus, for example, is both specific and, to a certain extent, a disease of locality.

The majority of the diseases of microbic origin are strikingly affected by variations of thermometric and atmospheric conditions, but are unaffected by details of food. Dietetic diseases, on the other hand, are easily traced to their source, for the same cause is responsible for every case, and it seems probable that, if the origin

of osteo-porosis had dwelt in food or water, its nature would have been discovered before this.

The writer, however, must frankly admit that osteo-porosis closely resembles the chronic type of rheumatism in many respects, and that it is possible that the pathological lesions are the result of a chemical irritation arising, not necessarily from the presence of microbes and their toxins, but from changes in the nutrient fluids directly determined by the climatic surroundings.

Contagion.—Until the true nature of a contagious disease has been proved beyond doubt, controversy rages around the question of spontaneous origin. And, even in these *fin-de-siecle* days, theories of spontaneity in diptheritic and similar affections find many supporters in the medical and veterinary professions.

Even since the discovery of the bacillus mallei, a well-known author wrote: "Whilst others, with whom I agree, contend that it (glanders) is capable of spontaneous origin." It is often a difficult matter to connect the case under consideration with a previous one, and this probably accounts for those instances which supposedly originate *de novo.*

Many of my osteo-porotic patients have no actual in-contact history, and many cases do appear to be of spontaneous origin; but, for all that their owners or I know, an osteo-porotic carcase may be buried in every pasture in the district.

Two experiments with transfusion of blood from diseased to healthy animals were unsuccessful.

In one stable which has suffered severely from the ravages of this disease the animals stand in two rows facing each other, and it has been remarked that the animals next (there are no stall partitions) or opposite to the diseased animals are often affected. Out of a batch of twelve unbroken native horses introduced into this stable three years ago, only one has escaped this affection. In another stable osteo-porosis prevailed several years ago, and slaughter of the affected animals was followed by cessation of the disease. A filly, which lost her dam at birth, was stunted in growth, and osteo-porosis was diagnosed when two years old; a colt which was allowed to run with her soon manifested similar symtoms. In one stall in a private stable three successive cases occurred. These instances could be multiplied.

Symptoms.—The primary sign may be either emaciation or lameness, or both may appear at the same time. Occasionally an animal for several months simply shows an unaccountable lack of condition, the abdomen is peculiarly drawn up, and at the end of a long ride or drive a sensation of stiffness is communicated to the person handling the reins. I have seen this incubative period exist for eight months, during which time an uncertain diagnosis of osteo-porosis was merely inferred because of the absence of positive symptoms of any other disease. Usually, however, the anæmic appearances are conjoined with two other symptoms—lameness and a slight but perceptible stiffness of the hind extremities. If the animal is groomed and well cared for the coat remains shining and glossy in spite of the loss of flesh. The appetite and natural secretions and excretions of the body are unaffected, and both pulse and temperature will be found normal. There is no noticeable depression of the animal's courage and temper

whilst at rest, but a little exercise quickly develops the latent weakness, especially when a steep grade has to be tackled.

Where lameness is the sole primary indication, diagnosis is impossible, and its peculiarities may cause the pardonable error of a diagnosis of rheumatism. The lameness arises from no ascertainable cause, presents no marked physical features, is prolonged in duration, defies medical treatment, is often intermittent, and frequently metastatic. It is but rarely that the seat of the lameness can be localised by simple inspection of the affected limb, for it is usually unattended by heat, pain, or swelling. I am inclined to think that the shoulder and hip joints are those which are most frequently affected.

We have, then, in the primary stages of osteo-porosis a loss of condition nearly always conjoined with lameness. The minor symptoms are those associated with other chronic diseases of a similar nature. Sometimes the animal appears to have difficulty in mastication. The diagnostic symptom is an enlarged condition of the superior and inferior maxillary bones, which almost invariably ensues sooner or later. I believe that there may be occasional cases in which this symptom is absent, but they are probably rare. I have in mind a grey gelding which was affected with inflammatory swellings of the knee and hock joints, with excessive lameness and emaciation, which I considered to be due to osteo-porosis, although the maxillary enlargements were not present. The enlargement may be confined to the superior maxilla, or both that bone and the inferior maxilla may participate. In an examination for soundness, where prominent superior maxillaries are met with, it is sometimes a difficult matter to decide whether these are normal or abnormal, for these bones may appear rounded and bulging in perfectly healthy young animals; and, again, the swellings of osteo-porosis may be so slight as to be hardly recognisable. The practitioner, in such a case, must be guided by the previous history, the appearance of the animal, and the ability to stand a severe test of endurance.

We will imagine that the case we are considering has passed through the first stages and is now in poor condition, "drawn up" in the abdomen, lame in one, two, or all four legs, evincing signs of increasing paraplegia, has difficulty in rising, especially after the prolonged rest of the night, and the swollen maxillaries clearly stamp him as an osteo-porotic wreck; now, if allowed to drag on a useless existence, the day surely comes when the partial paralysis becomes complete, and death results from decubitus.

But, at the point we are speaking of, an unexplainable improvement often takes place, the animal fattens, and the symptoms of lameness become modified, although a certain degree of stiffness is always seen. This partial recovery occurs independently of medicinal treatment, and constitutes the partial "cure" mentioned in a report read before the members of a veterinary Society in Pennsylvania, U.S.A.

It is, however, a more satisfactory and economical procedure to destroy osteo-porotic animals as soon as the disease is recognised, for unless fodder is very cheap the amount of work they perform rarely pays the feed bill.

The fatal termination of osteo-porosis is very prolonged, and diseased animals will sometimes hang on to a crippled existence for two

or three years if uninterfered with. Very few animals are allowed to die from its effect; as soon as uselessness is extreme, slaughter rings down the curtain upon another poor life.

I have not seen the more acute type of this disease described by Varnell, nor has there been any discoloration of the mucous membranes in my cases.

Prognosis and Course.—In all cases it is advisable to instruct the owner either to destroy the animal or to have it removed to a more favourable location. The course of the disease is variable. Emaciation may be rapid and lameness acute, or the reverse. Inexplicable improvement may appear, and continue for several months before the inevitable relapse. Small animals sometimes keep in good condition for years, and the presence of the disease is only evinced by the swollen maxillaries and occasional stiffness. But, as a rule, after the disease has established itself in the system, the animal is of little use, and destruction is preferable for humane and economical reasons.

Differential Diagnosis.—Osteo-porosis may be confounded with the following diseases:—

1. *Simple Lameness*, which can only be distinguished clinically if there are pathognomic symptoms (*a*) of the lameness, or (*b*) of the disease.

2. *Rheumatism*, which cannot be distinguished from osteo-porosis unless the marked emaciation or diagnostic indications of the latter disease are manifested.

3. *Laminitis.*—In the earlier stages of osteo-porosis, before the disease is sufficiently pronounced for a diagnosis to be made, a long journey will often be succeeded by extreme stiffness, in which every structure of the locomotory apparatus seems to participate. The animal is almost immovable, and the symptoms resemble those of laminitis. There is not, however, any marked febrile disturbance, the feet show no inflammatory symptoms, and the attack is very transient, passing off in a day or two.

4. *Helminthiasis.*—The intestinal forms of verminous disease may simulate osteo-porosis, if the presence of that disease is only indicated by loss of condition. But where intestinal helminthiasis is advanced the "hide-bound" condition of the coat, pallid (slightly tinged with yellow) mucous membranes, anal irritation, and presence of worms and ova in the fæces suffice to indicate its existence. Moreover, of the four characteristic symptoms of osteo-porosis—emaciation, lameness, stiffness of hind parts, and enlarged maxillaries—two, at least, are generally to be noted.

Therapeutics.—I have treated this disease with many medicinal agents (calcium phosphate, potassium iodide, mercurous chloride, arsenic, strychnine, antiseptics, cathartics, counter-irritants, absorbents, tonics, hæmatinics, etc., etc.), and have at times been flattered by deceptive appearances of recovery, but the end has invariably been the same. The recoveries resulting from change of locality contrast strongly with the inadequacy of drugs. Even if the animal be reduced to a skeleton, and almost unable to walk, he is still capable of ultimate utility if this measure be adopted. Two thorough-bred animals, each four years old, were in the last stages of this disease; they were removed to a dry district, well fed, and allowed the run of a small paddock. Restoration to normal health was effected in three months.

But though the animal waxes fat and regains the full vigour of health and strength, the enlarged condition of the maxillæ is a permanent change. I do not know what the effect of re-introduction into the damp District of O. would be.

A BRIEF COMPARISON OF THE VARIOUS METHODS WHEREBY HORSES ARE CASTRATED.

By H. CAULTON REEKS, F.R.C.V.S., Spalding.

BEFORE commencing what I have to say on this subject, I beg to offer a few words of apology to Professor Hobday for taking as my text the title of a paper recently contributed by him to the Southern Counties Veterinary Medical Association. In this paper he says :—

"What I propose to lay before you for discussion are certain conclusions arrived at as the result of observations made upon between 350 to 400 horses with the various kinds of instruments now in general use. I shall ask each one of you to say what instruments you have given a fair trial, and what are the ultimate conclusions you have come to."

That, I take it, is offering a fair and open field for anyone who has read his paper to step in and state his experiences. At any rate, that is my excuse, and Professor Hobday will, I am sure, take anything I have to say in the light of fair and honest criticism.

Preparatory to noticing any special method of operation, it will be as well to first consider what are the means that Nature herself takes to prevent serious and fatal hæmorrhage. It is necessary to do this in order to bring a full and unbiassed judgment to bear on our consideration of surgical methods. Nature's efforts to bring about a natural hæmostasis fall distinctly under two headings, viz., TEMPORARY means and PERMANENT ones.

The Temporary Means consist in :—

1. *The coagulation of the blood in and around the wounded vessel.* This, of all the means adopted by Nature, is by far the most important. Did not the blood possess this special property of coagulation, it would continue to drain away from any cut vessel, no matter how small, until death ensued. Although this coagulation is of itself sufficient to arrest the arterial flow in vessels of a certain size, Nature beneficently makes this further provision. As the blood flows there comes about a greater degree of coagulability, owing to alterations in the blood itself.

2. *The lessening in force of the heart's action* as the patient becomes faint plays a very considerable part in the arrest of the blood flow. As every one may see, the forcible spurt from the mouth of a divided artery with each contraction of the ventricle opposes strongly any formation of a blood-clot around and within the cut vessel. With increasing faintness the heart's impulse becomes weaker and weaker, until the spurt is almost imperceptible. This gives the blood time to form an adherent coagulum in the vicinity of the wound, and points

are several bleeding points, it recommends itself particularly to the veterinary surgeon as a ready and safe means of arresting hæmorrhage when castrating.

It is abundant proof of the intrinsic merit and advisability of this operation over all others that it is the one now in most general use wherever there are horses to be castrated. Also at the Royal Veterinary College, London, it is still used on all animals that are treated for subscribers; all other methods being regarded with a patronising air, and relegated as new-fangled ideas to the background of the Free Clinique. That it is so safe as to almost warrant one in saying it is absolutely so, there can be no denial. For many of the other methods I doubt whether that much may be said.

The actual cautery blocks up the artery by a thick slough or eschar, and the human surgeon is always on his guard lest, when this eschar separates or is cast off on the sixth or eighth day, he may be troubled with secondary hæmorrhage. That this is not the case with veterinary patients I think a long list of castration cases would conclusively prove. For my own part I have never yet seen it.

3. *Torsion.*—This in veterinary practice is, I believe, resorted to on this one occasion only—the occasion of castration. Properly employed it is of the greatest value. Veterinary practitioners are not yet fully alive to the advantages derived from a careful and judicious use of the artery forceps when operating. By their means a bleeding vessel of large size may be taken up and hæmorrhage securely stopped.

In veterinary castration what is known as *limited torsion* is practised—*i.e.*, the vessels are held quite close with one pair of forceps or clams while another pair are employed to slowly twist the cord until the whole of its structures have given way. The pressure of the first pair of forceps or clams prevents the ruptured intima and middle coats (which, bye-the-bye, are the first to give way) from turning up properly into the lumen of the vessel. What is known as *free torsion*, viz., seizing the bleeding vessel itself in a pair of artery forceps, without the medium of a first pair of clams to hold it with, and twisting it in the direction of its long axis, is almost impossible to practise in castrating the horse. That it is the best means of employing torsion there can be no doubt; but that limited torsion is sufficient for our purpose those who have practised it appear to testify.

4. *Forci-pressure* is a mode of arresting hæmorrhage that consists in seizing the end of a bleeding vessel with a pair of forceps with short blades somewhat deeply serrated, and long scissor handles, provided with a catch to keep them closed. These forceps are fastened with such force as to crush the end of the vessel between the blades. On relaxing their hold after a grip of a few minutes no bleeding takes place. The human surgeon, to make closure of the vessel more certain, gives the forceps a few turns, and so employs free torsion at the same time. Or he may leave the forceps, still gripping the vessel, in the wound for twelve to twenty-four hours, thus conjointly employing pressure and forci-pressure.

I have described forci-pressure at some length for this reason. It will be seen that in reality it is the method in which a good many instruments that have come to the fore in late years do their work. I am alluding to the various forms of crushing emasculators, *e.g.*, the écraseur, in its many different patterns, the emasculator of Webb,

the original instrument as invented by Blake of Ryde, and such modifications of the Blake instrument as the Huish-Blake and the "Reliance" castrator of Arnold. All these and their like are simply means of employing forci-pressure to arrest the hæmorrhage. True, they sever the cord at the same time; some with a serrated cutting edge and some with a smooth one, but the last act they all perform is the simple one of forci-pressure. When used they one and all should be kept for some few minutes tightly closed on the cord; for to effectually stay the hæmorrhage the artery must be *crushed.* Consequently, it follows that when choosing an instrument one that offers the best crushing surface will turn out to be the most reliable tool. Also, it is wise when purchasing to see that the serrated teeth or roughened blades of the instrument catch the cord before the cutting edge descends on it. I once had one form of instrument in my hands when a sharp-cutting knife severed the cord before the serrated teeth of the instrument had time to grasp it and perform the last stage of the double operation. The cord severed with the knife-like edge slipped back into the scrotum, and a very extensive hæmorrhage resulted. My own experience of all these instruments is that they are unreliable, and my reasons for so saying I will give later. When time is an object and horse-flesh of little value, they may certainly be relied upon as being convenient and portable. There is no fire to build, they necessitate no second journey, the operation does not last long, and they may be used for either the standing or recumbent mode of operating. That they have advantages with regard to the safety of the animal I feel bound, from what I have seen, to deny.

5. *Ligature.*—This, I need hardly say, is a means little resorted to by veterinary surgeons for the arrest of hæmorrhage from wounded arteries. A short perusal of the subject in contemporary medical literature is sufficient to point out why this should be so. That it was undoubtedly employed by the later Roman surgeons is evident, but with the decline of surgery in the Dark Ages it fell almost completely into disuse. In 1552 it was re-introduced by one Ambrose Paré, surgeon to the King of France, but so slowly did it make its way that Sharpe, in 1761, found it necessary to formally point out its many advantages over styptics and the cautery, giving as his reason that "it was not as yet universally practised by surgeons residing in the more distant counties of our kingdom."

Seeing that it took two centuries to successfully promulgate the use of this simple and efficacious method of arresting hæmorrhage—the simple tying up of a spouting artery—it is evident there must have been some strong reason. That reason was this: Surgeons of that day were ignorant of nature's means of occluding arteries, and consequently did not know how to best apply a ligature to these vessels or what kind of ligature to employ. To make all safe, they fell into the very errors they should have attempted to avoid. Noticing that such was the case with medical men, I am sure I keep well within bounds when I say that the veterinary surgeon of to-day is not sufficiently acquainted with the correct methods of applying ligatures for the arrest of hæmorrhage. It is not largely practised at our veterinary schools, and certainly it is not taught there. But for the fact that Professor Hobday mentioned ligature in his paper, I should not have mentioned it at all. I would, however, beg respectfully to

point out that if the ligature is to be adopted in veterinary practice, it will necessitate careful and special teaching both orally and practically.

The way in which a ligature should act if properly applied is to rupture the internal and middle coats of the vessel, turning them up so as to form a plug. The external coat it should leave intact. To obtain these results a careful knowledge and understanding of the material to be used will be necessary. It should be neither too thick nor too thin. If too thick, the inner coat of the artery is left untouched, and secondary hæmorrhage is to be looked for. If too thin, it eats by a process of ulceration through the vessel wall and comes away with the fibrinous exudate there present after the expiration of some days. Secondary hæmorrhage is again a result, and the artery has to be tied again higher up.

If of unabsorbable material the *strictest* attention (attention not always possible in veterinary practice) must be paid to antiseptic measures; or the ligature becomes infected with putrefactive matter, acts as a seton, and ulcerates its way out again with secondary bleeding. If of absorbable material the very greatest care must be given to the matter of its preparation, for the act of rendering it aseptic too often will also render it unabsorbable or of such consistence as to make tying it a matter of the greatest difficulty. These with other matters, including the proper tying of knots, are all yet for the veterinary student to learn.

Regarding the application of ligature in castration I have nothing but suggestions to offer. It must be remembered that in the severed spermatic cord of the horse we have several bleeding spots. To apply a ligature in the best possible manner would mean taking up each one of these and tying it separately. That would mean time. A further plan, though to my mind theoretically not so safe, would be to take a needle threaded with the loop end of a doubled piece of silk, pass it through the non-vascular portion of the cord, remove the needle, and then thread the loose ends of the silk each of them through the loop. This drawn up tight and fastened round the cord in a reef-knot will form what I believe is called a Staffordshire knot. After making all safe, excise the testicle. Always, however, where there is likely to be suppuration, ligaturing a vessel is not exactly the safest way in which it may be closed. With the suppuration the ligature will come away, and secondary hæmorrhage is likely to result. Until our antiseptic measures in veterinary practice are much improved I am afraid the ligature must be left alone. Personally I think this offers an excellent opportunity for some one with time to spare and means, to do a little original and interesting work of investigation.

I have now considered four of the principal surgical means (now in use) of staying arterial hæmorrhage in castration, viz.:—Pressure, Cauterisation, Torsion, and Forci-pressure. I have given each one a fair trial and now offer my ultimate conclusions. It is only fair to add, however, that it is cauterisation and forci-pressure that I have had the most experience with. Having said that, I will first dispose of pressure, as employed by the wooden antiseptic clams, and torsion.

Concerning Pressure.—I have before said that it is safe and reliable. It may be performed with the patient standing or recumbent, and there is no hæmorrhage into the scrotum. Its only disadvantage,

and it is a formidable one to a practitioner with a busy practice, is that it necessitates a second journey to remove the clams. For that reason it has not had an extensive trial from me.

Torsion I have employed some few times, and must say that in every instance it gave satisfaction. It is on purely theoretical grounds that I have really not given it a fair trial. I do not think that limited torsion, as we apply it (simply grasping the whole of the cord in one pair of clams and twisting it off in its entirety with a second), can be a safe and surgical method of stopping the hæmorrhage. It still remains for some one with a long list of cases spread over a period of some years to convince me to the contrary.

Forci-Pressure, as performed with the various instruments I have indicated, I can speak of with more certainty. We have used it in our practice from 1893 until quite recently. The first instrument used was the original one of Blake. For some two or three years we had no great cause for complaint. Then, as time went on, and the animals operated on began to arrive at the ages of two, three, and four years, we (I am quoting my father's cases, now, in addition to my own) received complaints from various owners that the colts we cut were a great deal thicker in the scrotum than they should be. The complaints even went so far as to say the animals appeared, some months after they were cut, as though they had never been operated on at all, and that their appearance was such as to seriously affect their sale as geldings.

Putting that on one side, a careful revision of our cases pointed to several instances where hæmorrhage was, to say the least of it, dangerously excessive. Not that ever a colt died from it, but it was sufficient to cause anxiety and alarm. It was also noticed that cases of abscesses appearing in the scrotum (abscesses of a large size) were a great deal too frequent. These abscesses were of sufficient size and gravity to render the patients' condition alarming. Even recovery from imminent danger was followed by a long period of weakness, debility, and general lassitude. *Always*, no matter how careful the operator may be, there is hæmorrhage, varying from a few droplets to a stream of some few minutes' duration, from the cord. This collects in the scrotum, and forms an excellent culture-ground for every kind of putrefactive and pathogenic bacterium.

The other side of the picture is undoubtedly attractive. I refer to those cases in which only a few droplets of blood are spilled and the wound heals by first intention. When that happens one is sorely tempted, in face of all other reverses, to still adopt a method that is likely to bring about such a result. After so short a period as three or four days it requires a rather close inspection to see that the animal has been recently castrated. No unsightly swellings of the scrotum and no disfiguring effusions of the sheath are present, and the owner and operator alike are charmed. Could we but ensure this happy state of affairs occurring in even 80 or 90 per cent. of our cases, then this method would be the one *par excellence*.

My experience, however, goes to show that these cases are the rare exceptions, and that in the majority of animals operated on with these emasculators hæmorrhage in a greater or lesser degree may be looked for. A few moments' reflection will show that the principal artery may be so surrounded with the enveloping tissues of the cord

was because I reflected, in the first place, that the conclusions arrived at on the question by former Congresses have so far been practically useful, as they have called wide attention to the value of good meat inspection, and that therefore even repeated discussion of the subject may be useful from this point of view. In the second place, I was moved to undertake the preparation of a report by the fact that the Berne Congress (at which I presented a report on the sterilisation of the flesh of tuberculous animals) took up on this subject a very different position from the former Congress, and, although not expecting to convert my opponents, I would nevertheless hope that by making a complete statement of the extent to which I dissent from them, the Berne conclusions may be given a practicable shape.

Let us in the first place notice the resolutions that have been adopted by the former Congresses. The Brussels and Paris Congresses demanded the condemnation of the flesh of all tuberculous animals, irrespective of the extent of the disease. The first and second Congresses, held in 1888 and 1891 respectively, took up the same position. However, at the last-named Congress there was received with applause a motion by Arloing, which, without surrendering the principle of total condemnation of the flesh of tuberculous animals in the raw state, was in favour of submitting all tuberculous flesh to sterilisation, heating, or salting, and approved of withdrawal from consumption only when the quality of the flesh itself makes it necessary to condemn it.

The conclusion of the third Congress on tuberculosis (1893) again proclaimed the necessity for sterilising the flesh of tuberculous animals, and recommended that sterilising apparatus should be provided in slaughter-houses. It would hence appear as if this Congress regarded the use of the flesh of all tuberculous animals as dangerous and requiring to be sterilised. However, when one examines more closely the reasons put forward by the mover of the resolution (Nocard), one recognises that the term "tuberculosis" referred only to generalised tuberculosis, and did not include the case of animals affected with other forms of the disease.

Lastly, the Berne Congress (1895) limited the condemnation of the flesh of tuberculous animals to those cases in which "on account of their extent and character the tuberculous lesions must be regarded as dangerous." The authors of the various reports presented on the subject expressed themselves as follows:—

Butel was in favour of the total condemnation of all tuberculous flesh; he regarded the entire carcase of every tuberculous animal as dangerous, and considered sterilisation the only means by which the flesh could be rendered safe for consumption.

Guillebeau expressed the opinion that the flesh of tuberculous animals, even when it appears normal, contains tubercle bacilli, but believed that the bacilli were quickly destroyed by heating to a temperature of 70-80° C. He, therefore, thought that in districts in which it is the custom to eat the flesh only in the cooked condition it might be passed as fit for food after removal of the caseous lesions, while in countries in which it is eaten in the raw state the sale of the flesh of tuberculous animals should not be permitted except in the Freibank or in the sterilised condition.

The third reporter, Ostertag, was, unfortunately, not present, and

he had not sent in any report. His view on the subject, which will be found in his text book on "Meat Inspection," and which has found almost general acceptance in the German States, is based upon a distinction between *local* and *generalised* tuberculosis—a distinction which had previously been drawn by Johne.

Ostertag takes up the position that not every tuberculous carcase is to be regarded as dangerous.

At the Berne Congress I myself contributed a report confined to the subject of the sterilisation of the flesh of tuberculous animals. I showed that in sterilisation we possess a means of rendering tuberculous flesh, which otherwise would have to be destroyed, fit for human consumption and non-injurious to health. Only in those cases in which the cost of sterilisation would exceed the value of the flesh is it better to destroy the latter. I expressed myself in favour of sterilisation in cases in which Koch's bacilli are present in the flesh, either in the muscular tissue, the muscle juice, the lymphatic vessels or glands, or the veins. I did not, however, by this intend to say that sterilisation is necessary whenever one or two bacilli are present; on the contrary, I believed "that the bacilli must be present in considerable numbers." I believed that it was only in such cases that the flesh would prove infective when introduced into the intestine.

Eventually Butel altered his motion in favour of "conditional condemnation of the flesh," and thus obtained a majority in favour of the resolution already mentioned.

I now come to the consideration of the position of the defenders of "unconditional" (total) condemnation, and that of the advocates of "conditional" (partial) condemnation.

The former consider that the flesh of tuberculous animals, meaning thereby the muscular tissue and the neighbouring soft parts, is dangerous even when the morbid process is of very slight extent, *e.g.*, when the bacilli occur simply in the lungs or bronchial glands; they consider that such flesh must be regarded as actually injurious, and therefore requiring to be condemned. They cite experiments in which animals have been experimentally infected by the injection of blood and muscle juice of tuberculous animals. Negative results of such experiments cannot, they allege, invalidate the conclusions to be drawn from the experiments yielding positive results.

On the other hand, the advocates of partial condemnation assert that in many cases of tuberculosis the virus has not travelled beyond the limits of the organ first attacked, or, at least, not further than the lymphatic glands belonging to such organ. It is alleged that within the body tubercle bacilli are disseminated solely by the lymph stream, and that they do not reach the circulating blood or the muscular tissue. The process thus remains localised, and only the actually diseased parts contain tubercle bacilli and are dangerous for human health. And the danger would not be very great even if tubercle bacilli were to gain access to the blood stream. Experiments on this head have shown that, even in very advanced cases of tuberculosis, the flesh or the muscle juice is only exceptionally capable of infecting experimental animals, and even then a positive result is obtained only by inoculation, and not by attempts to infect through feeding. Experiments have, further, shown that the blood and flesh of the living body are not appropriate media for the growth of the tubercle bacilli,

and that, even when the disease is very far advanced, it very seldom happens that many bacilli are present in the flesh of tuberculous animals. But a few bacilli taken in with the food would not be in a position to injure human health. The supporters of these opinions, therefore, consider that condemnation is necessary only when the extent of the disease gives occasion to fear "that the flesh contains a large number of bacilli."

In carrying out practical meat inspection, it is not possible to give effect to the view that flesh containing only one or two bacilli should be condemned. I am, therefore, in favour of a "conditional condemnation"—that is to say, condemnation in those cases in which the clinical and pathological examination of the slaughtered animal by the meat inspector indicates that numerous bacilli must be present.

As already mentioned, Johne and Ostertag have laid down rules by which a "local" may be distinguished from a "generalised" tuberculosis.

From the point of view of meat inspection, the tuberculosis is held to be "local" when the disease is confined to the organ originally attacked, or to the parts standing in immediate lymphatic connection with that. On the other hand, the disease is "generalised" when the tubercle bacilli have been distributed with the blood and have set up tuberculous lesions in other organs.

Two forms of generalised tuberculosis are distinguished. The first is the "chronic generalised" tuberculosis, in which only relatively small numbers of bacilli gain access to the blood, but in which the act is several times repeated, so as to lead to the infection of other remote organs by means of the blood stream. This form is associated with few urgent symptoms.

The other form of generalised tuberculosis is "acute miliary tuberculosis." In this form a large number of bacilli within a short period gain access to the blood, and, in consequence, tuberculous emboli are developed in many places, widely separated from one another. As a rule this condition is accompanied by very acute symptoms, determined by a tuberculous process which may be termed "tuberculous septicæmia," and also by the sudden development of the disease in several organs. There are, of course, transitional stages between the two forms.

When, following the introduction of tubercle bacilli into the blood, tubercles have developed in certain organs, a further infection in this way does not occur, and if the individual survives the blood infection (as is almost always the case with the irruption of a moderate number of bacilli), the process may be further spread to various organs by means of the lymph stream. In such cases, where the process of generalisation has come to an end, one may speak of a "multiple local tuberculosis." This term may also be applied when tubercle bacilli have penetrated into the body from the outside at several places, so as to determine a primary infection of a number of organs. Such infections may occur independently of one another—*e.g.*, in the lungs, intestine, uterus, etc.—or the one may be the consequence of the other. Thus, an apparently "primary intestinal infection" may in reality be secondary, and the result of a primary lung infection, the intestine having been infected by the swallowing of sputum.

The introduction of the terms "local" and "generalised" tubercu-

losis into meat inspection ought to enable the inspector, after he has completed his pathological examination, to immediately decide as to whether the carcase should be passed or condemned. In local tuberculosis (provided the muscular tissue or flesh is not involved) condemnation would be limited to the locally affected part, the remainder of the carcase being passed; whereas in generalised tuberculosis the unconditional and complete condemnation of the entire carcase would be necessary.

However, if one takes up the position that the flesh of tuberculous animals is to be condemned when it contains many tubercle bacilli, and admits that even in generalised tuberculosis only a few bacilli may be present in the flesh, it follows that the introduction of the terms "local" and "generalised" has not quite so much value for the practical meat inspector as might at first sight appear.

In the first place, the term "local tuberculosis" is, at least theoretically, to be used with care. It has been pretty generally accepted that tuberculosis, especially in cattle, has a pronounced tendency to remain localised to the tissue near the point of entrance of the agent of infection and to the neighbouring lymphatic glands, and that it seldom proceeds beyond these limits. To explain this appearance it is assumed that the lymphatic glands adjoining the part first attacked keep back the tubercle bacilli for a considerable time, after the manner of a filter.

If the disease spreads the extension may take place either by the lymph stream or the blood stream. The latter method frequently comes into play when the walls of a capillary or of a vein become involved in the process.

Provided the tuberculous process does not remain confined to the lymphatic glands first attacked, but gradually creeps along the lymphatic vessels to a second or third group of glands, the disease will still be regarded as a local one, just as if it had not extended beyond the group first attacked.

The fact that the lymphatic glands implicated may show various morbid changes, from reddening and œdematous swelling to ultimate caseation and calcification, is explainable on the supposition that the tubercle bacilli remain in the lymphatic glands and exercise their pathogenic action in the tissue of these glands. As a matter of fact, it is known that the lymphatic glands have the power of arresting corpuscular elements, and they may in this way keep back tubercle bacilli. It does not by any means necessarily follow, however, that a tuberculous lesion confined to a lymphatic gland may not at some time detach tubercle bacilli into the circulating blood, provided it is not completely isolated from the sound tissue after the manner of sequestrum. Furthermore, it is not probable that a lymphatic gland will arrest all the bacilli that have penetrated into it, but rather that it will allow many to pass, and that some of these may gain access to the blood through the large lymphatic vessels. Indeed, anatomical and physiological considerations would lead one to think that this must be the rule, and that therefore emboli and generalised tuberculosis would occur much more frequently than is actually the case. The harmlessness of the entrance of tubercle bacilli into the blood stream, and the non-occurrence of emboli and their consequences, is explainable by the experimentally demonstrated fact that tubercle

bacilli introduced into the blood in small numbers disappear or are destroyed there, and it may be concluded therefrom that the blood is not a favourable medium for the life of the tubercle bacillus.

It follows that even in a local tuberculous lesion, provided it is not yet completely isolated as a sequestrum, tubercle bacilli may gain access to the blood, but that they are as a rule without any injurious effect there owing to their being quickly destroyed.

In the strict sense of the word, therefore, there is no such thing as a localised tuberculous process. But when, in spite of the fact that bacilli pass from a lesion to the blood, the process remains localised, this is not solely the effect of the filter action of the lymphatic glands, but is mainly to be ascribed to the property of the circulating blood, in virtue of which the tubercle germs are in most cases destroyed.

In occasional cases this does not appear to occur. Thus, observations have shown that in cases of pronounced local tuberculosis of the bronchial and pulmonary glands, with subsequent secondary infection of the mesenteric glands through the swallowing of sputum, examination of the lymphatic glands embedded in the muscles furnishes no definite result, but that a few rather old tubercles are found in the kidneys. Obviously these can have had their origin only in bacilli transported into the kidneys by means of the blood stream.

Such cases do not come under the head of chronic generalised tuberculosis, in which tubercles are formed in many organs in consequence of a continual infection of the blood, nor can they be regarded as examples of "multiple local tuberculosis" of hæmatogenous origin, in which continual blood infection has come to an end after the development of secondary tubercles. Such cases show that the blood occasionally fails to destroy small quantities of tubercle bacilli.

Ought the knowledge of these facts to prevent us from passing the flesh of animals affected with the so-called "local tuberculosis"?

I must answer this question with a decided negative, for in the great majority of cases the presence of a few bacilli in the blood and flesh is not actually injurious; and although it is true that in certain very rare cases the tubercle germs become carried in the blood stream to remote organs, and there lead to the formation of occasional small lesions, it does not follow that the entire carcase is dangerous to health.

In what cases, it may now be asked, ought the flesh of tuberculous animals to be condemned as dangerous to human health?

I.—In the first place, this is the case in acute miliary tuberculosis.

In acute miliary tuberculosis great numbers of bacilli suddenly gain access to the blood; the previously chronic tuberculous process then takes on an acute character, and serious symptoms set in.

At the *post-mortem* examination in many cases tuberculous lesions visible to the naked eye are to be found in very few organs. For the most part they are only to be discovered on microscopic examination.

The presence of large numbers of bacilli in the blood involves a great danger to human beings eating or handling such flesh.

Reference must here be made to the recent valuable investigations by M'Fadyean.[1]

[1] "The Situation and Order of Development of the Lesions in Bovine Tuberculosis." By J. M'Fadyean. *See* this Journal, September 1898.

In the first place, this author, on the ground of *post-mortem* examinations conducted by him, describes the organs which may be found diseased in cases of bovine tuberculosis, and gives an account of the lesions that were present in six cases of very advanced tuberculosis. He then combats Ostertag's opinions with regard to the signs of generalisation, and asserts that many organs, such as the liver, spleen, kidneys, and many lymphatic glands, more readily become affected by the lymph stream than by the blood stream—a view with which I can only partially agree.

He then described three experiments with cows, in which he injected large quantities of tuberculous material into the jugular vein. The cows, which after a short time were slaughtered on account of urgent symptoms, all showed acute (hæmatogenous) miliary tuberculosis of the lungs. On macroscopic examination the bronchial and mediastinal lymphatic glands were found to be diseased, the others normal, with the exception of the second case, in which a pharyngeal and a prescapular gland were tuberculous. To a naked-eye examination in these cases of acute miliary tuberculosis the lungs were found to be the main seat of disease, but on microscopic examination the liver and spleen in the first case, and the spleen in the third, were found to be tuberculous.

From these results M'Fadyean draws the following conclusions:—

1. Infiltration of the whole of the lungs with tubercles of approximately the same size is a never-failing proof of generalisation.
2. In the absence of the lungs, a naked-eye examination of the other organs affords no criterion with regard to generalisation of the process.
3. In cases of generalised tuberculosis the spleen, liver, and kidneys may show no macroscopic lesions even when myriads of embolic tubercles are visible in the lungs.
4. The tubercles which are found in the spleen, liver, and kidneys, and in the lymphatic glands generally, on macroscopic examination, are generally the result of lymphogenous infection, and no proof of generalisation by means of the blood stream.

It must be observed with reference to these conclusions that M'Fadyean had in view only the acute miliary tuberculosis which is fatal and always accompanied by striking symptoms, but not the chronic generalised tuberculosis.

The diagnosis of acute miliary tuberculosis in the slaughtered animal requires the presence of a great many (not merely a few) embolic tubercles of approximately the same size in the lungs. Hence, in order to prevent the possibility of any doubt, the examination of the animal before slaughter is indispensably necessary, so as to observe whether acute urgent symptoms are present.

M'Fadyean's fourth conclusion I can endorse only with a large reservation. In chronic generalised tuberculosis the organs mentioned become infected by way of the blood stream, as is evident from M'Fadyean's own experiments. The fact that the liver, kidneys, and spleen show tubercles, while these are absent from many of the deep-lying lymphatic glands, merely proves that infection of the lymphatic glands by means of the blood stream takes place more slowly and requires a larger amount of the virus than the other organs, or than infection by means of the lymph stream.

The experiments cited also prove that in cases of acute miliary tuberculosis:—

1. The animal shows acute symptoms of disease, and
2. On macroscopic examination miliary tubercles are not to be found in various organs.

M'Fadyean has also published other experiments[1] which show the dangerous character of the flesh in cases of acute miliary tuberculosis, which might have been inferred from the large number of bacilli thrown into the blood stream.

* * * * * * *

These experiments, and others by different authors which I omit to mention here, show that when the number of bacilli entering the blood is not great the flesh may be regarded as comparatively harmless.

In the cases above referred to, the blood and muscular tissue were found to be virulent only once, but the popliteal glands three times. This shows that the admission of very many bacilli into the blood renders the lymphatic glands more dangerous than the muscles and blood, and that in such cases the muscles, on account of the lymphatic glands in them, are highly dangerous.

In view of the fact that the infectivity of the material was proved by inoculation and not by feeding experiments, it may again be asserted, in harmony with the results of earlier experiments, that "even in acute miliary tuberculosis the flesh is dangerous in only a few cases."

II.—In addition to the cases of acute miliary tuberculosis, the flesh of tuberculous animals ought to be condemned when it contains a large quantity of infective material.

This is frequently but not always the case in chronic generalised tuberculosis.

I should be in favour, for example, of excepting from condemnation cases in which chronic generalisation has not led to the development of embolic processes in the muscles and in the lymphatic glands belonging to them—cases in which not many bacilli have gained access to the blood. This would apply also to cases of generalisation involving several of the internal organs, but in which tubercles have not been formed either in the deep-lying lymphatic glands or in the muscles.

Animals affected with chronic generalised tuberculosis seldom appear to be very ill during life; in many cases, indeed, their general condition is excellent.

When tubercles are not present either in the flesh or in the lymphatic glands the carcase should not be condemned, even although the kidneys and spleen contain tubercles.

When I speak of the lymphatic glands of the muscles I mean only those that are deep lying and belong exclusively to the muscles—not the superficial groups which may be infected from tuberculous lesions of the organs or serous membranes in their neighbourhood. The carcase is therefore to be condemned when tuberculous processes are found in the muscular tissue or the lymphatic glands of the muscle.

I ought here to observe that no scientific educated meat inspector

[1] **"The Infectivity of the Blood, Muscular Tissue, and Lymphatic Glands in Generalised Tuberculosis of the Ox." By J. M'Fadyean.** ***See* this Journal, December 1898.**

will condemn the carcase in every case in which generalised, but not acute miliary, tuberculosis is present, and in which, although the organs are diseased, there are no lesions in either the muscular tissue or its lymphatic glands.

The objection that in chronic generalised tuberculosis the muscular tissue and glands may have become involved in the morbid process at the moment of slaughter or a short time previous, although no visible lesions are present in these parts, may be opposed by the statement that in such a case the number of the bacilli would not be large.

III.—On practical grounds I must add to the cases already mentioned, those in which there is a "multiple local tuberculosis."

In such a case examination of the muscular tissue and its lymphatic glands, especially the latter, shows that these have been infected with tuberculosis, and that from them the virus has been further disemminated, especially by way of the lymphatics; the presence of such a large quantity of infective material in the flesh would be dangerous to human health, and therefore in such a case condemnation ought to be carried out.

In the cases included under the headings I. and II., the condition of the lymphatic glands will enable the meat inspector to decide.

Of course, the whole of the flesh cannot be examined, nor is it necessary that all the lymphatic glands should be diseased; it is sufficient if single groups of deep-lying lymphatic glands show lesions which cannot be ascribed to direct infection from tubercles in the adjacent organs or serous membranes. In this connection it ought to be observed that disease of the lymphatic glands is not always manifested by the presence of tubercles visible to the naked eye; œdema, hyperæmia, and swelling of the glands may also be signs of tuberculous disease.

I think I have now enumerated all the conditions on which the flesh of tuberculous animals ought to be condemned. By way of completion I would here add:—

1. In cases of so-called local tuberculosis the diseased parts of the carcase must be condemned, but the remainder should be passed.

2. In generalised tuberculosis the same rule ought to be followed, except in cases of (*a*) acute miliary tuberculosis, in which the whole animal ought to be condemned, and (*b*) of chronic generalised tuberculosis with lesions in the muscular lymphatic glands (or muscles), in which case also total condemnation is to be practised.

3. In multiple local tuberculosis the same rule ought to be followed as in chronic generalised tuberculosis, that is to say, the whole animal must be condemned when lesions are present in the muscular tissue or its lymphatic glands.

I will only add to this that in cases of healing of tuberculous lesions, calcification of tubercles, etc., the healed parts may be regarded as not dangerous.

I should consider my task as not completed if I did not devote some words to a number of other points which must be taken into consideration in judging the carcases of tuberculous animals. These are as follows:—

1. Emaciation and wasting. These two conditions, which may be

the consequence of tuberculosis, in judging the carcase of a tuberculous animal must be kept separate from the term tuberculosis, and be given independent consideration. If the tuberculous disease by itself would not justify condemnation of the carcase without the emaciation or wasting, then condemnation must be practised not on the ground of tuberculosis but on account of the wasting. Even if the latter is the consequence of the former it is still an independent ground for condemnation.

2. A "bad appearance" of the flesh must also be mentioned. This term, the significance of which varies with the individual using it, must also be kept separate in judging the flesh of tuberculous animals. The question whether a bad appearance of food materials is by itself injurious to health is possibly very interesting, but in any case it is quite distinct from the question whether tuberculous flesh ought to be condemned.

3. Lastly, I entirely agree with Ostertag in thinking that all doubtful cases ought to be condemned.

What, it may next be asked, ought to be done further with the flesh of tuberculous animals? With respect to this point two general rules may be laid down.

1. The uncondemned carcases and the uncondemned parts of tuberculous animals should be passed without any restriction.

2. Condemned carcases and the condemned parts of tuberculous animals must be sterilised.

I must here devote some words to the questions of "Declaration" and the "Freibank." I consider it absolutely unnecessary, and from the owners point of view very unfair, that flesh which is not injurious should have to be sold with a declaration, or in the Freibank in countries in which that institution is recognised.

In this respect I should like to dissent from the motion which I put forward at the Berne Congress, moved thereto by a desire to secure unanimity; the recommendation there made goes decidedly too far. At the same time, a declaration is in many cases necessary. It frequently happens that parts of tuberculous animals which are not in themselves dangerous become soiled with infective material, by the various manipulations carried out during slaughter or in the removal of infected parts, and are thereby made injurious. Such flesh may harbour many tubercle bacilli on its exterior, but these, on account of their superficial position, will be destroyed by simple boiling or roasting; such flesh I would have sold with a declaration or in the Freibank, with an intimation that it must be well boiled or roasted. Even in these cases sterilisation would be preferable, were it not that it detracts too much from the value of the meat.

On the other hand, condemned flesh must always be sterilised provided the cost of sterilisation does not reach or exceed the value of the flesh itself. Simple boiling and roasting are not adequate substitutes for sterilisation. The sterilised flesh must be sold with compulsory declaration or in the Freibank, since the purchaser has the right to be informed regarding its source.

With regard to the question of compensation an International Congress is not the proper place for determining regulations.

Moreover, at the present time, when the owner possesses a practi-

cable method of diagnosis in tuberculin, I hold that compensation is not absolutely necessary; the public require at the least flesh from healthy animals, and the seller is morally bound to supply the same. If he intentionally or carelessly fails to do his duty in this respect he ceases to have any claim to compensation. If, for example, compensation had to be paid out of a local rate, it might easily happen that such a place would become the market and place for slaughtering tuberculous cows from the whole of the surrounding country. On the other hand, it might be expected that compensation would act in favour of regulations intended to combat tuberculosis in general, or facilitate the carrying out of general meat inspection in a kingdom or province; in this way it might be useful to grant reasonable compensation to owners who have complied with the legal requirements.

It must also be observed that the owners are very well able to protect themselves in this matter by means of a system of insurance. In many cases it may therefore be in the interests of authorities to give administrative or even financial support to these insurance agencies.

What has been already said defines accurately enough the position which I take up with regard to the conclusions of the Berne Congress, and I therefore refrain, in view of the limited space at my disposal, from entering into a more detailed consideration of these.

The following are the resolutions which I desire to submit to the Congress:—

1. In view of the danger to human health which is involved in the use of the flesh of tuberculous animals, the inspection of animals intended for food both before and after slaughter is necessary.

2. The flesh of tuberculous animals is to be condemned, (*a*) in cases of acute miliary tuberculosis, and (*b*) in cases in which tuberculous lesions are present in the muscular tissue or its lymphatic glands.

3. In all other cases the flesh is to be passed, but only after the diseased parts or organs have been condemned.

4. In those cases in which the flesh, although itself not injurious, is outwardly soiled with infective material, it ought to be passed for sale with a declaration or in the Freibank.

5. Cases which appear of a doubtful character must be condemned as dangerous.

6. Condemned flesh and condemned organs must be sterilised, provided the commercial value of the flesh after sterilisation is not less than the cost of the process.

7. The sterilised flesh and the sterilised organs must be sold with a declaration or in the Freibank.

8. The terms emaciation, bad appearance, unsightly character, and such like, have no importance in estimating the dangerous nature of tuberculous flesh, but they may furnish independent reasons for condemnation.

EDITORIAL ARTICLE.

THE PROCEEDINGS OF THE SEVENTH INTERNATIONAL VETERINARY CONGRESS.

THE Seventh International Veterinary Congress, which met in Baden-Baden in August last, probably deserves to rank as one of the most important and successful of the series that has yet been held. The custom of convening such international gatherings of veterinarians may be defended on several different grounds. In the first place, such a Congress generally offers considerable attractions from the mere holiday-seeking point of view. It furnishes an occasion for visiting places that are interesting in themselves, on account of their beauty or their historical associations, and it affords opportunities for pleasant social intercourse with professional friends of one's own and other nationalities. In this respect the most recent Congress was certainly not less successful than any of its predecessors, and great credit is due to the Committee responsible for its organisation, alike for the smooth working of the proceedings and for the arrangements made for the entertainment of the visitors.

In the second place, these international meetings serve a useful purpose in periodically focusing attention on subjects of high professional interest, and in recording the state of knowledge for the time being on the matters set down for discussion. It can hardly be expected that, as time goes on, this aspect of the Congresses will grow in importance, for with the growth of veterinary literature all important discoveries and new information relating to veterinary science soon become international property, and the opinions and practices of veterinary surgeons with regard to professional matters tend to a condition of comparative uniformity in all civilised States.

There is still another respect in which such conferences between members of the veterinary profession, drawn from all the principal States of the world, may have useful results. They inevitably draw public attention to the subjects deliberated upon, and, both by the interest which is thus excited and by the conclusions which are registered by the Congress, an impetus may be given in the direction of necessary legislation touching diseases of the lower animals. It must be admitted, however, that the history of past Congresses does not indicate that they have exercised great power in this respect, probably because, in spite of their name, some of them have been

much more national than international, and have thus been led to record resolutions which did not by any means represent prevalent international opinions on the subject in question. It naturally happens that the country in which the Congress meets furnishes the largest proportion of members, and when differences of opinion arise the decision arrived at may embody the views of the majority, and yet fail to find or to deserve general acceptance in veterinary circles in other States. An actual majority of the members of the most recent Congress were German veterinary surgeons, and, consequently, save with regard to the subjects on which opinion was unanimous, the resolutions passed by the Congress embody opinions which would probably not have received assent if the Congress had been held, say, in France or in this country. We propose to review briefly the principal subjects discussed by the recent Congress, and to offer some criticisms of the resolutions passed thereanent.

The first of the subjects was what is called International Veterinary Sanitation. This has been quite a favourite topic with previous Congresses, three of which have successively passed resolutions affirming the desirability of a uniform system of regulations to govern the international traffic in cattle. When it is understood that these regulations were to be carried out in conformity with an international convention which would have robbed individual States of the right to prohibit the importation of animals even from countries in which such diseases as pleuro-pneumonia and foot-and-mouth disease were prevalent, one can only marvel that so many years' consideration of the question has been necessary to convince the Congress of the absolute impracticability of such a scheme. At the Baden-Baden Congress Professor Hutyra of Buda-Pest proposed a resolution which virtually reaffirmed those passed on the same subject by the three preceding Congresses, and called upon the German Government to take the initiative in summoning a conference between representatives of the various States to discuss the terms of a convention regarding the international trade in animals. Previous resolutions on the subject may almost be said to have become stereotyped, and it must have been a disappointment to Professor Hutyra to find that the Seventh Congress was not at all disposed to endorse the decisions of its predecessors regarding this matter. By a majority the Congress rejected Professor Hutyra's resolution in favour of another, which declared that the time had not yet come for laying down definite principles regarding the international regulation of the traffic in animals. But the majority in favour of this common-sense view of the subject was by no means an overwhelming one, and it is not improbable that the next Congress will repeat the waste of time in discussing proposals which must always remain impossible of realisation.

The second subject of discussion was "the combating of foot-and-mouth disease"—a theme which is at present of engrossing interest

in Germany and some other Continental States, owing to the prevalence of the disease in question. A measure of the importance of foot-and-mouth disease for Germany at the present time may perhaps be found in the estimate that the loss occasioned by it in recent years years has exceeded one hundred million marks annually (£5,000,000). An interesting feature of the proceedings at the Baden-Baden Congress was a lecture by Professor Lœffler in which an account was given of the investigations conducted at the instigation of the German Government with a view to the discovery of some more efficient means of controlling the disease than those hitherto employed.[1] Although the inquiry has been in progress for nearly three years, Professor Lœffler was not in a position to bring forward any plea of protective inoculation which commended itself to the Congress, but he ventured to predict that "before the close of the century a good, practicable, and efficient method of protective inoculation against foot-and-mouth disease will be discovered."

Meanwhile the Congress passed a motion in favour of the continuance of the scientific investigations, followed by a series of resolutions setting forth the direction in which existing regulations against the disease ought to be strengthened. In the original draft of the resolutions to be submitted to the Congress one of them recommended that importation should be entirely prohibited from a country in which foot-and-mouth disease has broken out. It was represented by Professor Hutyra that this was an unnecessarily severe measure to take, and apparently in compensation for the disappointment to which he had been subjected in connection with the previous subject it was complacently agreed to amend the resolution so as to interdict importation not from the entire country but only from the "affected district" (verseuchte Gebiet). Veterinary surgeons in this country will be unanimous in thinking that the amendment was the reverse of an improvement, and the nation that endeavours to protect itself against foot-and-mouth disease by any such half measures will soon have occasion to repent of its lenience.

The third principal meeting of the Congress was devoted to the subject of meat inspection, and the discussion brought to light some slight differences of opinion regarding the employment of lay inspectors. In the end the Congress passed a resolution recognising the employment of such officials where the services of qualified veterinary surgeons are not obtainable, subject to the conditions that such persons should have been trained under veterinary inspectors, and that they should be constantly under the supervision of the latter. That, no doubt, correctly defines the rôle of the lay inspector, although there is evidence that in this country some people would like to endow non-professional persons with a much more important share of the work of meat inspection.

[1] *See* this Journal for March last, p. 79.

It is pretended that there are numerous places in this country where the services of a veterinary surgeon to inspect the carcases of animals slaughtered locally are not obtainable. It would be interesting if some one would specify a few places of that sort. We do not believe that any exist, and we are at a loss to comprehend why the services of a veterinary surgeon should not be everywhere obtainable to inspect a slaughtered animal, since it is undeniable that, at least on the mainland of England and Scotland, such services can everywhere be commanded in the case of a sick animal and for a very moderate fee.

The Congress also passed resolutions in favour of the introduction of a system of general meat inspection and the erection of public slaughter-houses. In the discussion Professor Ostertag expressed the opinion that international resolutions on the subject of meat inspection were likely to exercise a very important influence, and he cited as an illustration the International Congress for Hygiene and Demography, held in London in 1891, which had led to the erection of slaughter-houses in many towns in England. We fear that Professor Ostertag has over-estimated the influence of the Congress in question in the direction of stirring up public opinion regarding the sanitary importance of public slaughter-houses and efficient meat inspection. The reports of the two Royal Commissions on tuberculosis have doubtless done something to educate the public in these matters, but for the most part we are still without any meat inspection worthy of the name.

Among the subjects set down for deliberation at the Congress, the one that probably engaged most general interest was the means of combating tuberculosis. The discussion on this subject was opened by Professors Siedamgrotzky and Bang, who summarised the papers which they had contributed to the proceedings of the Congress; and in the end a number of resolutions moved by these two authorities were adopted. These declared (1) that there is urgent necessity to combat tuberculosis; (2) that voluntary measures of repression are practicable and deserving of encouragement; and (3) that the State ought to take measures to combat the disease. Other resolutions were carried recommending tuberculin as the best diagnostic agent at present known, declaring in favour of its employment being restricted to veterinary surgeons, and expressing the desirability of making it compulsory on the part of veterinary surgeons to notify cases of tuberculosis occurring in their practices.

It is worth while recalling the fact that at the previous Congress, held in Berne in 1895, a resolution was carried in favour of the compulsory use of tuberculin in all premises in which the disease had been detected. The experience of Belgium in the interval has shown the enormous difficulties which lie in the way of any attempt to stamp out the disease by the compulsory use of tuberculin in infected herds, and the Baden-Baden Congress could only recommend the employment of the agent as the best means of diagnosis at present known. It must,

unfortunately, be confessed that the test is not infallible, and the uncertainties that attend it come specially into play when the State endeavours to enforce its use. Probably the most serious of its defects, from that point of view, is the condition of tolerance for tuberculin which many tuberculous animals acquire after a few injections at short intervals. As long as it is permissible for anyone to inject his cattle with tuberculin whenever he pleases, the compulsory use of the test is out of the question. It is certainly desirable that the use of the agent should be controlled by law, but there is small probability that there will be any legislation in that direction in this country.

It is obvious, however, that the defect just alluded to scarcely affects the use of tuberculin voluntarily employed by an owner to purify his own herd of home-bred animals, but another defect, and, if Professor Bang's opinion is well founded, a most serious one, comes into play. As is well known, Professor Bang has been an enthusiastic advocate of the voluntary use of tuberculin, and his earlier writings on the subject held out to the owner of tuberculous herds the prospect of being able to gradually secure a clean bill of health by testing the whole of the animals and effecting a separation between those that reacted and those that did not. But, unless we have seriously misunderstood the article on the subject[1] which he presented to the Congress, the plan that he now recommends is a radically different one.

In the article referred to the author says:—"When one has to do with a large herd in which tuberculosis has been prevalent for many years, one may, as a rule, omit the testing of adult cattle. In such a case the majority of these will react even when they appear to be sound . . . In large tuberculous herds it is consequently better to include in the sound section only the calves and the non-reacting young cattle. In this way the owner is spared the pain of seeing that the majority of his cattle are not free from tuberculosis. For herds that are only slightly affected I always recommend that the whole of the animals should be tested." This appears to be almost a complete abandonment of the essential features of the Danish plan of eradicating the disease as it has been understood in this country. Frankly, we do not think that the advice is wise, and for the most part the new plan would be unworkable in this country. In the first place, it is to be feared that in the majority of our large herds now affected the disease has been in existence for many years, and there is plenty of experience to show that even in herds which the owners believe to be healthy the tuberculin test may disclose the unpleasant fact that, if not the majority, at least a large proportion of the adult cattle are affected. Professor Bang finds that a considerable number of adult cattle fail to react to tuberculin, but it would be a mistake to suppose that the test, as it has to be employed in ordinary practice, is infallible in the case of young animals. This must be recognised, and the owner

[1] *See* last number of this Journal, p. 197.

who wishes to quickly obtain a clean bill of health must not fall into the error of supposing that he has seen the last of the disease when he has disposed of all the animals that reacted to the first test. The test is not a mechanical one, or one that dispenses with all necessity for clinical supervision of the animals that have not reacted. It is always necessary to be on the outlook for clinical symptoms of the disease, and it is wise to test the non-reacting animals a second time after an interval of not more than three months.

We have space to notice only one other subject which served for discussion at the recent Congress, viz., the use of the flesh and milk of tuberculous animals. The resolutions passed by the Congress with regard to the meat question cannot be recommended for acceptance in this country. They are open to the objection that they are founded on a false interpretation of the situation of the lesions as an indication of the distribution of tubercle bacilli within the body, and sanction the sale of flesh in circumstances which make it probable that it contains tubercle bacilli. The only safe principle with regard to this matter is to condemn such parts of the carcase as may reasonably be supposed to have tubercle bacilli in them, and to pass the remainder. In some cases this rule demands total seizure, and in others it requires the condemnation of particular organs only. What is not justifiable is to permit the sale of flesh that presumably contains tubercle bacilli on the ground that probably only a small number of the germs are present. Furthermore, the demand for sterilisation of the flesh in particular cases of tuberculosis is illogical as long as its destruction in other cases is considered necessary, for it is not open to doubt that even in cases of acute generalised tuberculosis the entire carcase may be completely deprived of its dangerous quality by sterilisation.

The resolutions with regard to the milk question are open to less exception, but it would have been better to prohibit the sale of milk from any cow presenting clinical symptoms of tuberculosis, instead of limiting the prohibition to cases in which there is udder tuberculosis or emaciation. Lastly, it is very doubtful whether the granting of compensation for the slaughter of emaciated tuberculous cows or those affected with tuberculosis of the udder would act as a protection to the milk consumer. It appears to be not impossible that it might have precisely the opposite effect, by inducing owners to continue milking to the last possible moment cows that they know to be tuberculous, in the knowledge that in the end they can claim compensation.

Reviews.

Bacteria, especially as they are related to the Economy of Nature, to Industrial Processes, and to Public Health. By George Newman, M.D., F.R.S (Edin.), D.P.H. (Camb.), etc.; Demonstrator of Bacteriology in King's College, London. London: John Murray. 1899.

THIS work is not intended for the medical man or the veterinary surgeon, though it would be a great mistake to say that it would not repay perusal by either of these. It is a popular exposition of the main general facts of bacteriology, and, as the author himself admits, it is no easy task, in writing such a book, to strike the proper proportion between the popular and the scientific. Upon the whole, the author is to be congratulated on his success. He has succeeded in producing an interesting picture without undue elaboration of details.

The volume, which extends to over 300 pages, opens with a chapter on the biology of bacteria, and then follow separate chapters on bacteria in water, air, and soil; on bacteria and fermentation; and the bacteriology of milk and other food materials. The last three chapters are respectively devoted to the question of immunity and anti-toxins, bacteria in relationship to disease, and disinfection. A number of excellent illustrations are inserted in the text, and the book is well printed and handsomely bound.

At page 55 it is said that some bacteria "can live and multiply in sterilised water," a statement that is likely to puzzle the reader until it occurs to him that "sterilised" must be a misprint for "distilled." In the chapter on bacteria in milk the author speaks of the influence of "barn air" as a source of milk contamination. There may be parts of the country in which barn and cow-shed are synonymous terms, but barn is certainly not the common name for a building in which cows are kept. There are one or two more serious slips than these. The author erroneously includes convulsions among the common symptoms of rabies in the dog; and he states that "in the horse glanders particularly affects the nasal mucous membrane, forming nodules, which degenerate and emit an offensive discharge." The truth, of course, is that only a small minority of glandered horses have lesions in the nose, and that the nasal discharge of uncomplicated glanders is practically never putrid in odour.

We have called attention to these errors in order that they may be corrected in the next edition, and we commend the work as an interesting and up-to-date popular account of the *rôle* of bacteria in nature.

The Art of Horse-Shoeing. By William Hunting, F.R.C.V.S. Third edition. London: H. & W. Brown. 1899.

THE third edition of this admirable text-book does not demand a lengthy notice. On the occasion of its first appearance we pointed out its merits, and the fact that a third edition is already required is the most satisfactory evidence that it is fulfilling the purpose with which it was written. The text has received some slight corrections and additions, and the number of illustrations has been increased.

CLINICAL ARTICLES.

INFLUENZA AND ITS SEQUELÆ IN A MARE.

By W. M. SCOTT, F.R.C.V.S., Bridgwater.

THORACIC IRRIGATION—RECOVERY.

ON the 24th October 1898 I had a wire to see three horses which were found to be suffering from catarrhal influenza of the usual type.

In the course of ten days they apparently recovered, and I did not hear of anything further until 8th November, when I was again wired for, one of the three showing symptoms of catarrhal pneumonia. The disease was running a natural course, the patient maintaining her strength, and the lung clearing up beautifully until the 14th, when the right lung became intensely and extensively affected, while the left showed signs of relapse. The temperature, which had gone down to 102° F., now rose to 104·4°, with all the unfavourable symptoms distinctly marked.

On the 18th signs of pleurisy were noted, and by this time the patient was very prostrate. The appetite was in abeyance, and the outlook most unfavourable.

On the morning of the 27th hydrothorax was suspected, and evidence of the water-line was noted to be higher on the left than the right. This proved two facts—firstly, that the cribriform septum of the mediastinal pleura was blocked with flakes of lymph, and second, that the flow of the pleuritic fluid was greater on the left than the right.

The mare was tapped on the left side in the usual place on the 29th, and a dirty greyish unhealthy fluid with a most repulsive odour was evacuated. So offensive was the odour that the attendant was forced to leave the box, and if my memory does not fail me became sick. About nine pints were removed in all. The next day she was tapped on the right side, when about six pints were withdrawn. Two days later we tapped the left side again, when we found the fluid about the same in consistence, odour, and quantity. In all, the left side was operated on four times and the right twice. I may say in passing that material benefit seemed to be derived from tapping the right chest, but a directly opposite remark is to be made regarding the left side. Why that was so I cannot say.

On 4th December at 9 a.m., to use the attendant's description—"The mare commenced coughing, and kept it up for about half-an-hour, discharging a lot of matter from her nose—nearly half a gallon." This, too, had a most offensive odour.

It was evident that a pulmonary abscess had burst into a bronchus. I may here say that on auscultating the chest some few days pre-

viously one could detect the distinct metallic tinkling sound described in books, but by me never diagnosed in practice before. The sound was so distinct and characteristic that I feel constrained to mention it here, and there is no doubt whatever that this abscess cavity gave way during the paroxysm of coughing and discharged its contents. At this stage I discussed with the owner the advisability of having the mare destroyed or of opening the chest and irrigating that cavity as an experiment. As I had the privilege of doing that gentleman's work by contract he decided on the latter. The following morning I incised the skin at the site which I had previously employed for tapping on the left side, directed a lancet in between the two ribs, and made a slit. I then pushed my index finger as far into the tissue as possible, and inserted a silver tube, slightly flattened so as to have an oval section, into the chest. This tube was about four inches long, and at its external end was welded a piece of plating with two slits in it, so that tape or cord could be fixed and tied round the chest to keep the instrument in position. The greater part of the fluid having been drained away, I had the mouth of the tube so constructed as to retain a piece of rubber tubing, the other end of which I had fixed to the tube of an aspirator. The bottle connected with the aspirator could hold 20 oz., and it was filled with a solution of izal (35 m. to a pint of water). One pint was injected at a time, and after a few minutes withdrawn. Three pints were injected altogether, the animal taking it well and showing no inconvenience. Three injections were used in all, and these every third day. The fluid used was as near as possible gauged at 100° F., and of the same strength throughout. The canula was left *in situ*, remaining for fourteen days, at the end of which time it fell out and was not reinserted. Purulent matter continued to drain away, and when the animal coughed an increased flow resulted.

Daily an improvement could be noticed in the character of the pus, and from an unhealthy, turbid, stinking fluid it became a clear, creamy, odourless pus.

The tube having been removed, the wound did not heal for over a month, during which time a continual but gradually decreasing flow kept the sinus pervious. The patient was now practically a skeleton, but good nourishing food was supplied *ad lib.*, and even delicacies were not withheld. Cod liver oil, eggs, malt, gruels, wines, and whiskies were administered for some ten weeks later, until the owner, getting tired of the treatment, decided to turn her out. Some three weeks after she was turned out I saw her again, when we pronounced her more a scientific curiosity than a useful animal. She showed all the indications of broken wind. I did not again see her for some months afterwards (10th July), when, to my surprise, she galloped round the paddock, to all appearances in the pink of condition. She had gained wonderfully in flesh. On auscultation I was equally surprised to find no trace of functional or organic pulmonary disorder. In short, to all appearance the mare had made a complete recovery. When galloped no inconvenience in respiration could be detected, nor would she grunt when "ribbed." She has been put to the horse, and is believed to be in foal.

Deductions. — I think that several lessons may be drawn from this case. Probably the most important of all is that it teaches us

the wonderful recuperative powers of nature, and, with that, the evident tolerant qualities of the thoracic organs. This case also adds one to the list of recoveries in animals showing a septic odour in the breath, and, further, I am almost convinced that a modified stench was emitted from the body itself, showing how permeated the system must have been. It proves, also, that thoracic irrigation in equine practice is practicable, and that no danger can follow the insertion of a large tube through the chest wall and leaving the same there; also, that injecting fluid slowly into the cavity is not followed by evil results. I do not maintain for one moment that the injection of izal alone saved the horse's life; but still I have had four cases of empyema in horses previous to this one, and all have died where irrigation was not used. I think that by inserting a fairly large drainage tube nature is given a most useful way of ridding herself of a deadly poison, and, on the strength of that, the next case of empyema I get I shall open the chest and insert a drainage tube. It is no use tapping and removing a few pints, for in my experience reaccumulation is sure to take place.

Medicinally, I saturate the system with ac. salicylic combined with ammon. carb., and later with quinine. I also order daily inhalations of iodine fumes, taking care of the eyes. Of course nutrients and stimulants must not be forgotten, and bitter tonics during convalescence, of which the best is nux vomica with acids. The box must be daily saturated with antiseptics. I am strongly of opinion that the administration of absorbents is contra-indicated in cases of empyema. They only facilitate the ingress of the poison into the system, the patient succumbing to the effects of toxins and organism cultivated within its own economy.

A CASE OF CÆSAREAN SECTION.

By JAMES LAITHWOOD, F.R.C.V.S., Congleton.

IN 1883, when I was assistant to Mr Tedbar Hopkin, F.R.C.V.S., of Manchester, a half-bred Russian poodle was brought to the infirmary in a state of collapse from dystokia, having been in labour all the previous day. On vaginal examination it was found that only the ribs of a pup could be touched; every endeavour to remove it failed, and Cæsarean section was decided upon. As she was too weak to bear an anæsthetic, the hair was closely removed from the flank and the skin dressed with 5 per cent. carbolised oil. An incision through the skin was made, about 1½ inches in length, in an oblique direction towards the hip, the muscle fibres being separated and the uterus withdrawn. The latter was incised, and five pups, together with their placental membranes, were removed; four of them were alive, and the fifth, which was dead, was about twice the normal size, and the sole cause of the mischief.

The abdominal wall and muscles were then sutured with carbolised catgut, and the skin with carbolised silk. A pad of cotton wool and a bandage completed the operation. The bitch was then wrapped in

warm flannel and a stimulant administered, but she showed little signs of revival for several hours. The next morning she seemed brighter and a laxative was administered, followed up by a little sherry and beef tea. She was fed on beef tea and milk for the next fortnight, eventually making a good recovery.

I subsequently showed the patient at a meeting of the Lancashire Veterinary Medical Association, but since then I have been unable to trace her.

CASTRATION OF A HERMAPHRODITE.

By FRED. HOBDAY, F.R.C.V.S., Royal Veterinary College, London.

IN July last I was consulted by Mr Philip Turner, M.R.C.V.S., of Ixworth, regarding a hermaphrodite Suffolk cart horse, which was a continual source of trouble to its owner.

The animal was three years old, and possessed a small thin penis which measured, when extended, 9¼ inches long, and protruded back-

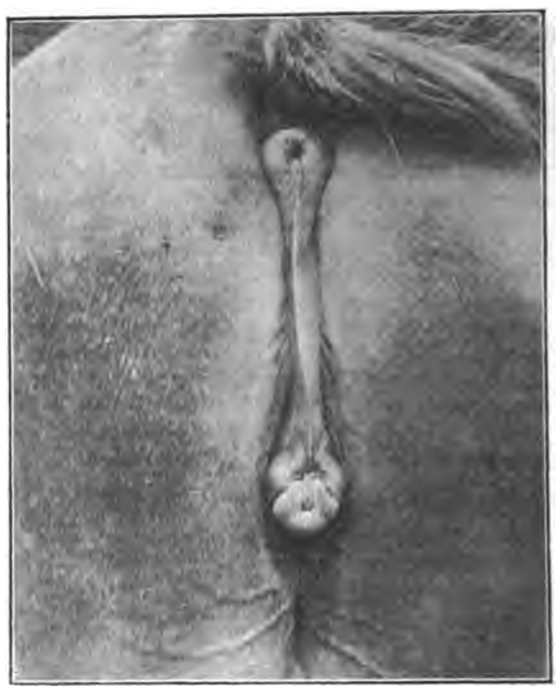


FIG. 1.

wards in the perineal region in the usual situation of the vagina in a mare. When in contact with another animal, either horse or mare, the penis would become protruded and erect. Urination took place through the penis, the stream being directed backwards. There was no sign of scrotum, and in its place was a mammary gland with well

developed teats (*see* Fig. 2). Castration was decided upon, and the operation was performed, by the kindness of Mr Henry Phillips, at his veterinary infirmary, Ipswich. The animal was cast in the same way as for cryptorchid castration, and, under aseptic precautions, a search was instituted up the inguinal canals, where, in each case, a tolerably large testicle was found. Both were well out of sight, close to

FIG. 2.

the internal abdominal rings. These were removed with the écraseur, and recovery was uneventful. I heard from Mr Turner a few days ago that the horse, since the operation, had given every satisfaction, and was perfectly quiet with other animals. For the photographs I am much indebted to Mr Granville Heskell, a Class A student and pupil of Mr Phillips.

SUPERNUMERARY DIGITS IN A PIG.

By R. G. SAUNDERS, M.R.C.V.S., Colonial College, Hollesley Bay, Suffolk.

THE subject of this note was a pig (born on the College farms last May and one of a litter of nine) which possessed on each fore limb two extra digits, equal in size to the normally developed third and fourth digits. There was apparently a duplication of the whole foot (or manus), from the carpus downwards, of both limbs, except that the two inner large digits were unprovided with the two small digits

behind, which do not reach the ground in a normal foot; otherwise the extra foot seemed quite as well developed as the other. The pig grew well until he was sold and killed a few days ago, and had not the slightest difficulty in progression.

I thought a dissection would prove interesting, so after death I procured the fore feet, one of which I dissected, finding the arrangement of the parts as follows. There were only five metacarpals—four large ones, and a small one to the outside forming the fifth digit. The other small digit (II.?), which during life appeared to belong to the outer of the two feet (being included in the integument of the latter), was found to be attached to the lower end of the metacarpal supporting the fourth digit of the inner foot.

I was only able to procure the feet cut off just above the carpus.

FIG. 1.

The extensor pedis muscle evidently consisted of several portions which terminated above the carpus in five tendons, which were distributed to the digits as follows: (*a*) an outside one ending on the pedal bone of the fifth digit; (*b*) another bifurcating just above the lower end of the metacarpal, one portion going to the fifth digit and the other to the excentric side of the pedal bone of the fourth; (*c*) a third, common to the two large (outer) digits, bifurcating at the first interphalangeal articulation and ending on the pyramidal eminences of the pedal bones of the third and fourth digits respectively; (*d*) a fourth dividing half way down the metacarpal of the third digit, one slip going to the excentric side of the terminal phalanx of this digit and the other to that of the second digit (II.?); (*e*) a fifth tendon, common to the two large (inner) digits, and arranged in the same

manner as the outer common tendon (*c*). All these tendons received slips from the palmar interosseous muscles.

At the posterior aspect of the foot I found the perforatus muscle ending in two tendons, which, passing down behind the third and fourth digits of the outer foot (and after forming sheaths for the two tendons of the perforans going to these digits), became attached to the second phalanges of these two digits. The other digits were unsupplied with tendons from this muscle.

The wide flat tendon (just an inch broad) terminating the perforans muscle divided at the middle of the metacarpal region into six terminal branches, each digit receiving a branch. Underneath this tendon were the plantar interosseous muscles (representing the sus-

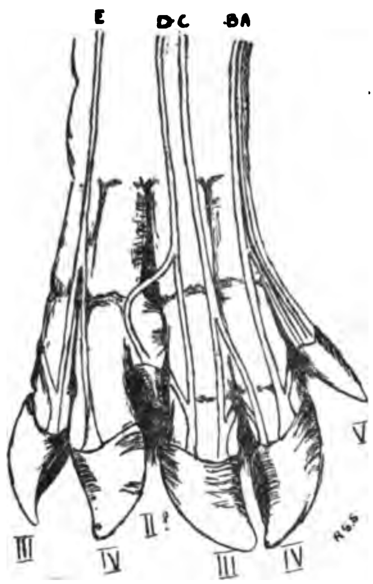


FIG. 2.
Left fore foot of pig, showing distribution of extensor pedis tendons.

pensory ligament of the equidæ), consisting of five portions, corresponding to the five metacarpals.

The carpus showed no great abnormality as far as the number of bones went, there being an extra one in the upper row, suggesting an extra scaphoid, making five in all, and the four bones normally present in the lower row. The trapezium articulated with the two internal metacarpals, whereas normally it has no relation with the digits. All the metacarpals articulated with the carpus except the external (V.), which only articulated with the metacarpal next it. The two internal metacarpals, instead of a ginglymoid articular surface inferiorly, had a rounded head with no groove, forming, with the first phalanx, in each case more or less of an enarthrosis. The three internal digits and the external one were provided with only one fully-developed sesamoid. The first phalanx of the small middle

digit, instead of articulating directly with the metacarpus, had an irregular-shaped bone interposed between it and that bone.

Throughout this note I have described the case as one of dichotomy, or bifurcation of the limb from the carpus downwards, and such I believe it to be. During the animal's life there seemed no doubt about this, as here were six digits, whereas, as Bland Sutton says in his *Evolution and Disease*, "no vertebrate animals other than fish and Ichthyosaurii possess on each limb more than five digits; therefore, when the number of toes or fingers exceed on each limb this typical number, it must, if we regard the accessory limb as atavistic, be a reversion to an Ichthyosaurian or a fish form. The distance is far too great, and in doing so we violate the rule that atavistic parts

FIG. 3.
The same foot, showing the arrangement of the bones.

do not belong to forms palæontologically remote or systematically far distinct."

On the other hand, dissection revealed the fact that one of the small digits had no metacarpal of its own and no connection with the carpus, therefore it might be argued that here was a case of reversion to an ancestor with five functional digits, the small middle digit being the result of dichotomy of the second (in this case) digit from the first interphalangeal joint downwards. But I do not think that this argument can hold good, for in a case of reversion it seems very unlikely that the thumb, which is normally suppressed in the pig, would attain the proportions that it has in the present instance. It is curious that, although the small middle digit had no bony connection with the outer foot, it should have been supplied with a slip from the tendon of its third digit.

DISPLACEMENT OF THE PELVIC FLEXURE OF THE COLON, LEADING TO ENTERITIS AND DEATH.

By the Same.

LATE on the evening of 31st July last I was summoned to see an eight-year-old bay gelding belonging to a small farmer. The only history obtainable was that the animal had been out at grass for the last four days, and had been brought in that morning very stiff in both hind limbs, tender over the loins, and passing dark coloured and high smelling urine. He had not been feeding during the day. The fæces were normal and had been passed regularly.

He was standing quietly when I saw him, with a sleek, healthy coat and regularly distributed surface temperature. However, the visible mucous membranes were bright scarlet in colour, the pulse 80, small and thready, respirations 18, and temperature 105·5°. I gave a dose of opium and oil and left him for the night, with directions to be watched. I should say that, although he walked very stiffly, I was unable to detect any tenderness by pressure over the loins.

1st August. He had lain down twice during the night and rested quietly for about a couple of hours each time He walked slightly less stiffly and was eating a little hay, but his breathing was more rapid and somewhat noisy, with marked nasal respiration and a thin discharge from the nostrils. There was slight sweating on the inside of the thighs. He was still passing normal fæces, and the urine was lighter in colour. Pulse 92, rather smaller in volume, respirations 32, and temperature 106°. The high temperature, rapid breathing, and absence of bowel pain forced me to the conclusion that I had a case of pneumonia to deal with, although there had been no noticeable rigors, the extremities kept warm, and I could detect no abnormality of lung sounds by stethoscopic examination. I tested the urine for albumen, but failed to detect its presence. He received doses of quinine with stimulants. At 7 P.M. the pulse, respiration, and temperature show a delusive slight improvement—namely, 84, 22, and 105° respectively. He had been feeding fairly during the day, and had lain down at times.

2nd August, 9 A.M. He was still feeding fairly and drinking his usual allowance. He had been passing urine normally, but he had not dunged for some hours. Pulse 80, respirations 40, and temperature 105·8°. At 9 P.M., although he was quiet and feeding, the owner informed me that from five o'clock he had been purging, and groaning during defæcation. From this and the previous slight constipation I suspected some intestinal disorder, and administered a drench of opium and chlorodyne, leaving others to be given during the night if in pain.

3rd August. He had been up and down all night and in pain, but when I saw him he was quietly feeding, although occasionally he would paw with a fore foot. His coat maintained the glossy look of health, the limbs kept warm, and there was much borborygmus. Pulse 88, respirations 40, shallow, temperature 106·4°, and membranes

still very bright. On rectal exploration the colon was so full and tense that I could hardly pass my hand along the rectum, which took rather a downward direction; this seemed to give him much pain, and an enema was almost immediately ejected. He did not, from outward appearances, seem in nearly such a critical state as his temperature and pulse indicated. 4 P.M. I found him in great pain, walking round in small circles, covered with sweat, getting up and lying down and rolling every few minutes, groaning and grinding his teeth, violent expulsive efforts with grunting—in fact, every indication of severe enteritis with stoppage. Pulse 96, respirations 44, and temperature 106·8° During the next few hours he rapidly became worse. Sedative drenches and subcutaneous injections of morphia gave him little relief. The owner had sent to the knacker's to have him shot before my arrival, and, as he was anxious to have him put out of his pain, I consented to his destruction, as he was showing commencing signs of delirium.

Post-mortem.—I had to cycle a long distance before breakfast next morning to see him opened, and when I arrived the knacker had already removed some of the viscera, but he had not pulled out the pelvic flexure of the colon. On doing so my attention was immediately arrested by the termination of the second portion, which for about 15 inches was very dark in colour, while at its darkest portion there was a rupture about 3½ inches long, which apparently had occurred just before death, very likely when the animal fell after being shot, for very little of the ingesta had passed out into the abdomen and the edges seemed recent. On cutting through the inflamed bowel wall it was found to be much thickened from the infiltration of a straw-coloured exudate; especially was this the case with the submucous coat. The mucous membrane was almost black, forming a marked contrast to the yellow-coloured middle coats of the wall. The ingesta were mixed with blood, which had become almost black. The cause of this localised enteritis was the complete doubling of the pelvic flexure up over the end of the second portion and the commencement of the third portion, thereby producing complete occlusion of the bowel. This displaced portion was not markedly inflamed, while the third portion beyond it was apparently normal. Above the occlusion the colon was somewhat over-distended with ingesta, while beyond it the bowel was comparatively empty. All the other organs were normal as far as a cursory examination went.

Remarks.—It was somewhat remarkable that he exhibited no definite symptoms of bowel pain for two days, although affected from the very first, as shown by the temperature and pulse, with some amount of enteritis. Many of the classical symptoms of twist of the bowel, to which condition this should have borne a close resemblance, seem to have been wanting in this case; for instance, pain was intermittent until twelve hours before death, while stoppage was not very evident until after the attack of diarrhœa, which came on about sixty hours after the first symptoms of illness. It is hard to understand how a displacement of this description could have occurred in a gelding; it would be easy for the enlarging uterus of a pregnant mare to push the flexure out of the pelvic cavity, and in doing so to double it forward, but in a gelding such an accident seems unaccountable where there was no history of any accident or violence.

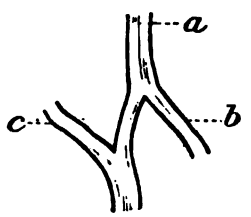
ABNORMAL DISTRIBUTION OF NERVE FOUND IN A CASE OF NEURECTOMY.

By HAROLD SESSIONS, F.R.C.V.S., F.H.A.S., Brighton.

IN June of 1898 I saw a hunter suffering from navicular disease. After carefully examining the leg, I advised the owner to have the operation of neurectomy performed on him. This he decided to do, and the horse was sent to me about the beginning of July.

The operation was performed in the ordinary way, without any difficulty whatever. The wounds healed nicely, but the horse still continued to go lame. Careful examination showed that there was still sensation on the outside of the foot. Thinking that possibly there might be two external metacarpal nerves, the horse was again cast, the operation being performed slightly lower down. Only the main branch of the external metacarpal nerve could be found. A piece of this was taken out and the horse let up. On examination, sensation was still found in the posterior part of the outside of the foot. It was very evident that there was some abnormal distribution of the nerve, as sensation was still being conveyed to that part of the foot.

As the horse was absolutely useless, and would have to be shot unless this piece of nerve could be found, he was again thrown, and



Dissected External Metacarpal Nerve and Branches.
a, Metacarpal; *b*, Anterior plantar; *c*, Extra branch (probably from the internal metacarpal) conveying sensation after division of the external metacarpal.

after he had been anæsthetised I determined to follow the course of the nerve down, until I found where the accessory branch came from. This I found a little below the fetlock, about half-an-inch below the point where the anterior plantar nerve is given off from the metacarpal nerve. It was about half-an-inch below the spot where the anterior plantar nerve passes between the artery and vein of the foot; and it was somewhat difficult to get at it.

The accompanying sketch shows the exact size and distribution of the nerves. After the separation of the accessory branch, sensation was taken from the foot and the horse went perfectly soundly.

The case is interesting as showing that although the ordinary operation of neurectomy had been accurately performed, yet there are instances in which the distribution of the nerves is so abnormal that a further operation proves to be necessary. The piece of nerve removed, from which the sketch is made, is in my possession.

STRICTURE AND DILATATION OF THE ŒSOPHAGUS DUE TO EXOSTOSIS ON THE FIRST RIB.

By ROBERT J. HICKES, F.R.C.V.S., Market Weighton, Yorkshire.

THE patient, a colt, was purchased at a public auction when a yearling. About two months afterwards a greenish discharge was observed to be coming from the nose, and a swelling was observed at the lower part of the jugular furrow. Some weeks later I saw the patient, which was being treated for strangles. The discharge, which consisted chiefly of masticated grass, had increased, and the swelling on the near side of the neck now extended to the angle of the jaw.

I diagnosed stricture of the œsophagus, and advised slaughter, as the animal was almost a skeleton

Post-mortem examination revealed an exostosis about the size of a duck's egg on the first rib, presumably the result of a fracture, and to this the œsophagus was closely adherent by strong fibrous tissue.

The œsophagus and stomach were carefully dissected out, inflated, and dried. The dilatation extends for a length of 18 inches from the pharynx to the first constriction, the circumference of the widest part being 11½ inches. Immediately below this constriction there is a further dilatation extending for 5 inches, the remaining portion (20 inches) between this and the stomach being of normal size.

Reports.

REPORT ON EXPERIMENTS IN REGARD TO THE TESTING OF CATTLE FOR TUBERCULOSIS.

CARRIED OUT BY THE CHESHIRE COUNTY COUNCIL.

AT a meeting of the Technical Instruction Committee of the Cheshire County Council held on 24th October 1898, it was resolved that the attention of the Committee of the Agricultural and Horticultural School, and the Committee of the Worleston Dairy Institute and Farm, be called to the desirability of applying the tuberculin test to their herds, in order to discover the extent to which the animals were affected with tuberculosis.

These Committees, on considering the question referred to them, recommended that the work of testing these herds should be undertaken by a Joint Committee of the two bodies, and that the Technical Instruction Committee should set aside a sum of money to be available for meeting the expenses incurred in carrying out the tests, as also of indemnifying the Committees for any loss that might be incurred.

This recommendation was agreed to, and a sum of £250 set aside for the purpose named, and the carrying out of experimental test work generally.

The interest in the question of tuberculosis in cattle was intensified by the

orders of the Local Government Board, and by the action of various Corporations and Sanitary Authorities in asking Parliament for additional powers to enable them to deal more thoroughly with the milk supplied to their areas, and the inspection of the cattle supplying that milk. This action of the Corporations was due to the opinions of medical and scientific men, that milk from tuberculous cows was largely responsible for the increased mortality in children, and that there was every reason to believe that a very large proportion of our dairy cattle were affected with tuberculosis in a greater or less degree. That proportion has been variously estimated at from 36 to 45 per cent. of the ordinary dairy cattle.

In the spring of 1899 the Royal Agricultural Society of England published and circulated a leaflet containing a number of suggestions for dealing with this question, in which it was stated that "it is a matter of certainty that a notable quantity of milk which is sold to the public contains tubercle bacilli," and advising farmers and milk sellers to use the tuberculin test for diagnosing the presence of the disease. Great doubt and uncertainty, however, existed in the minds of farmers, the agricultural community generally, and, indeed, of some veterinary surgeons as to the efficacy and reliability of the tuberculin test; also as to the loss that would be incurred in clearing their herds of animals thus giving indications of being affected.

It was felt, therefore, that if an independent and disinterested body, such as the Technical Instruction Committee of the County Council, would undertake a series of experiments in regard to this subject, much good might be done, and some of the doubts and fears set at rest. With the object in view, therefore, of educating the community in regard to the question of tuberculosis, and of throwing some light upon questions that were deeply agitating the public, as well as to set an example by purifying the herds under its own direct management from all taint of tuberculosis, the Committee undertook the series of experiments, and set aside money for the expenses incurred.

It was decided:—

1. To test the reliability, or otherwise, of tuberculin, as a method of diagnosing the existence of tuberculosis in an animal.
2. To analyse the milk of animals that reacted to the tuberculin test, and thus see what percentage of such animals gave milk contaminated with the tubercle bacilli.
3. To test if the appearance, and manual manipulation of the udder could be relied upon as indicating the presence of tuberculous milk in the animal.
4. To try and estimate the direct loss that would be incurred by a farmer in clearing his herd of all animals shown to be affected with the disease.
5. To conduct some experiments on animals that reacted, with a view to seeing:—
   - (*a*) Whether a cure could be effected at a reasonable cost.
   - (*b*) Whether the constant use of tuberculin itself had a curative effect.
   - (*c*) What was the effect upon the animal of regular and systematic injections of tuberculin.
   - (*d*) Whether, if an animal has not already tuberculosis, will the injection of tuberculin propagate that disease.

It was recognised that the experiments must be carried out in a very thorough and complete manner. That all the testing and examining and analyses must be undertaken by highly skilled and efficient men, and no trouble or expense spared in obtaining reliable results, as only in this way could the conclusions arrived at carry conviction to the minds of those for whose benefit the work was being undertaken.

The extreme importance of the question to the farmers of the country generally, and of Cheshire in particular, may be seen when it is remembered that the number of cows and heifers in calf or in milk in Great Britain in 1899 is 2,671,260, showing an increase of 84,070 over the previous year. Of this total number of cows, etc., 107,774 are in the County of Cheshire. Examining the returns for the several counties of England, we find that the proportion of cows and heifers in calf or in milk to the acreage under cultivation in crops or grass is as follows:—Cheshire, 200 cows per 1000 acres; Lancashire, 175; Derbyshire, 145; Staffordshire, 134; Somersetshire, 128; Cornwall, 117; Dorset, 112; the West Riding of Yorkshire, 111; while all the rest sink below 100, the lowest having but 33.

Persons Employed in Carrying out the Work.

The testing of the animals with tuberculin was placed in the hands of Mr Laithwood, F.R.C.V.S., chief veterinary inspector of the County of Cheshire. This gentleman was also retained to advise the Committe on the experiments to be further undertaken with some of the cattle that had re-acted.

The *post-mortem* examination of the slaughtered animals was undertaken by Mr Laithwood, assisted by Mr King, chief veterinary inspector for Manchester, and Mr Storrar, veterinary inspector for the City of Chester. Arrangements were made with Professor Delépine, of Owens College, Manchester, to undertake the microscopical and physiological analysis of the milk of all animals that re-acted, and of portions of the carcases of animals about which any doubts existed.

The *post-mortem* examinations were also witnessed by the Organising Secretary, and the first one by three farmers, who are members of the County Council.

Description of the Herds upon which the Experiments were Carried out.

1. The herd at the Dairy Institute, Worleston.

This consisted of fifty-four cattle, containing one high-class pure-bred shorthorn bull. The cows in this herd may be described as the farmers' ordinary shorthorn, with one pure-bred Jersey and a few cross-bred cattle from Welsh and Irish. A number of the animals had been bred upon the farm, but the majority had been purchased as required in the neighbourhood, and at the markets in Crewe and Chester. The cow-houses at Worleston were, until 1898, very inferior, being low and deficient in air space, and wanting in light and proper ventilation. In the spring of 1898, however, the shippons were remodelled, and accommodation provided whereby each animal has an air space of 378 cubic feet. Light and suitable ventilation are, however, still wanting. A plenteous supply of good and pure water is provided. The land on the farm is entirely grass, on a heavy clay sub-soil. The cattle were well fed, receiving some amount of artificial food throughout the whole season of milking; the production of milk being the one great object aimed at. Cattle that failed to milk satisfactorily had been from time to time weeded out and their places filled with others, while specially heavy milkers had been kept on from year to year. Hence the herd contained a fair proportion of aged cows, and heavy milkers. The majority of the cows were due to calve in the early portion of the year, though the herd contained some that had calved in the autumn and winter. Hence the herd may be classified as a typical farmer's stock, such as abounds throughout the county, and kept under circumstances, and in buildings similar to those ordinarily existing.

2. The herd at the Agricultural School, Holmes Chapel.

This consisted of seventeen animals, containing one high-class pure-bred and young shorthorn bull. The herd contained two Jerseys, one of which

had been purchased from Bucks., and the other bred on the farm. Two other cows were well-bred shorthorns. The others cross-bred. Almost all the animals were comparatively young, as the cattle here are often fed off, and consequently the stock is changed from time to time. The land on this farm is a clay loam, and the cow-houses are exceptionally good, being well lighted and ventilated, and each cow having an air space of 518 cubic feet. A good supply of water also here exists; the cows, too, are well bedded in the stalls with straw, and special attention paid to keeping them clean and tidy.

The Testing.

In testing the cattle, a dose of three centimetres of tuberculin was used, though this amount was varied a little according to the size of the animal. The insertion of the tuberculin was made, in most cases, a few inches in front of the shoulder joint, and in the remainder immediately behind the elbow. It is considered equally reliable in either situation, but Mr Laithwood prefers the former, it being slightly further removed from the hind foot.

The tuberculin used was obtained from Professor M'Fadyean, of the Royal Veterinary College, London, who guaranteed it to be of *recent* make, and *reliable*, and *his own preparation*. It is well known that if tuberculin is old, or turbid in colour, it becomes unreliable.

The temperature of each animal was carefully taken before injection, to obtain the normal temperature, and then taken after injection at regular intervals up to a period of fifteen hours after injection. It was considered that any rise of temperature after fifteen hours from injection may not be due to the effects of the tuberculin. Thus, Professor M'Fadyean says, "I do not think it necessary to take the temperature after the fifteenth hour."

In classifying the animals, as a general rule, those which did not rise above 103° were considered "healthy"; if over 103° and under 104° as "doubtful"; if 104° or over as "tuberculous." Several other things, however, have to be taken into account, such as the normal temperature, age, temperature of house, if recently brought in, if recently had cold water, or been fed, etc., etc., and of course parturition.

At the same time the udder of each cow that re-acted was carefully examined to see if any deviation could be detected from what should be its normal condition, or any indication that would point to an unsound or indurated udder.

[TABLES.

TABLE I.

Particulars of Cattle tested at Worleston, on 6th & 7th February 1899.

The tuberculin was injected on February 6th, from 9.30 to 11 p.m.

No. of Animal	*Colour.*	*Temperature of animal before injection*	*Temperature taken at 5.30 to 7 a.m.*	*Temperature taken at 8 to 9 a.m.*	*Temperature taken at 10 to 11 a.m.*	*Temperature taken at 12 to 1 a.m.*	*Classified as healthy*	*Classified as tuberculous*	*Classified as doubtful*	*Remarks on Cattle.*
1	Roan Bull	102·1	101	102	102·2	102	1			Bred on Farm, fourteen months old.
2		empty	stall							
3	Light Roan	102	102	102	102·3	101·2	3			Irish heifer purchased at Chester, Feb. 1st, 1899, just calved, in full milk
4	Red	101	101·1	102	102	101	4			Bred on Farm, 3ys. old, calved Aug. 1898
5	Red Roan	101·2	102	103·3	104	104·4		5		Irish heifer purchased at Chester, Feb. 1st, 1899, newly calved, in full milk.
6	Red & White	101·2	102	104·3	105	105·2		6		Good strong cow, fair milker, calved Jan. 10th, 1899, in full milk
7	Light Roan	101·3	102·2	102·2	102·3	101	7			Purchased in 1896, calved Nov. 1898.
8	,, ,,	101·2	102·3	104·1	104·1	104		8		Purchased in 1896, not in calf, in milk
9	Red & White	101·1	101	102·2	101·4	101	9			Purchased in 1898, in milk
10	Light Roan	101	101	103·1	102·1	102	10			Purchased in 1898, in milk
11	,, ,,	101	101·2	101·4	102·3	102	11			Purchased in 1897, in milk
12	Red & White	100·2	101·2	102	101·4	101	12			Purchased in 1896, calves in April
13	Light Roan	101	102	100·2	101·2	101·2	13			Purchased in 1895, due to calve in March
14	,, ,,	100·2	101	102·1	101·3	101·2	14			Bought in 1895, in milk
15	,, ,,	101·1	102	103·1	102	101·2	15			Bought in 1897, in milk, pay to feed
16	,, ,,	101·1	101·2	101·4	102·1	102	16			Bought in 1897, young cow, to calve in May
17	,, ,,	103	105·4	106	105	104		17		Bought in 1896, aborted end of Jan.
18	Red	100·3	101	102·1	101	101	18			Bought in 1897, in milk
19	Light Roan	101	102	102·2	101·1	101	19			Aged, very heavy milker
20	,, ,,	101·4	101·1	102	101·1	101	20			Bought in 1897, just at calving
21	,, ,,	101	102·2	102·4	101	101	21			Bought in 1896, just calved, heavy milker
22	Red Roan	102	103	104	104	105·2		22		Bred on Farm, just calved
23	Light Roan	100·4	101	102·2	102	102·1	23			Aged, heavy milker, at calving
24	Blue Roan	101·4	102·3	103	103	104·3		24		Bought in Wales, 1895, very hardy, just calved, in full milk
25	Red Roan	101	102·1	103	102·2	103	25			Aged, good dairy cow, just at calving
26	White	101·3	102	102	101	101	26			Aged, heavy milker, due to calve in Mar.
27	Red	102·4	103·1	104	103	102			27	Bought 1897, good milker, in calf, due to calve end of May
28	Light Roan	101·1	102	102	102·1	101	28			Purchased as heifer in 1895, good milker, due to calve in April
29	Roan	102·4	105·4	105	105	104		29		Bought in 1897, not heavy milker, just calved
30	Light Roan	101·4	104·4	106	105	104·2		30		Good milker, due to calve in May
31	Red	101·1	102·3	101·1	102	102·1	31			Bought in 1895, hardy, heavy milker for six months, then drops off
32	Light Roan	101·2	102·2	103·3	104·2	106		32		Bought in 1895, to calve end of March
33	Red Roan	102·1	102	102·2	101	102	33			Not a heavy milker, calved Jan. 1899, in full milk
34	,, ,,	100·4	101·2	102	101	101·4	34			Bought in 1898, due to calve in May
35	Red & White	103	103·2	103·2	102·3	103·2			35	Cross on Welsh, hardy, good milker, calved Feb. 9th
36	Red	100·3	102	103	102·2	103·3			36	Bought in 1895, very good milker, calved Feb. 4th, suspected of having quinsy growing
37	Light Roan	102	105	106	104·2	104		37		Bred on farm, nice young cow, due to calve in April
38	Red & White	101	102·2	102·2	101	101·2	38			Bred on farm, to calve in April
39	Red	101·3	101·3	103	101	102	39			Bred on farm, to calve in May
40	,,	101·2	101·2	103	101	101·3	40			Bred on farm, barren
41	Light Roan	101·2	103·4	105	103·3	105		41		Bred on farm, aborted her first calf
42	Red	102	103·2	105	103	105		42		Bred on farm, due to calve in April
43	Red & White	101·2	102·1	101	101·2	101·1	43			Bred on farm, barren
44	Red	101·1	102·1	103	102·3	102·3	44			Bred on farm, due to calve in April
45	Light Roan	101	101·2	102·3	101	102	45			Bought in 1897, calved in Dec. 1898.
46	Red Roan	102	102·1	102	102	102	46			Bought in 1897, due to calve in April
47	Jersey	100·2	100·2	101·3	101	101	47			Bought in 1897, calved in Dec. 1898
48	Red	101·3	102·3	102	102·4	103·2	48			Bred on farm, to calve in April
49	Light Roan	101·4	102	102·2	102·2	102	49			Heifer, purchased when a calf
50	Red & White	101·2	102	102·3	103	101·4	50			Heifer, bred on farm
51	,, ,,	101·4	104·6	106·2	106	105		51		Heifer, bred on farm
52	Light Roan	101·2	102·3	103·2	103·2	101·3	52			Heifer, bred on farm
53	,, ,,	101·2	102·1	103	103·1	101	53			Bought in 1898
54	,, ,,	101·4	102·4	103·2	103·2	102	54			Heifer, bred on farm
55	Bull	102	103	105·3	106	105		55		4 ys. 8 months old, pure bred, fine animal

TABLE II.

Cattle at Agricultural School, tested 14th and 15th February 1899.

The tuberculin was injected at 10 p.m., February 14th, 1899.

No. of animal	Colour	Temperature of animal before injection	Temperature taken at 6 a.m.	Temperature taken at 9 a.m.	Temperature taken at 11 a.m.	Temperature taken at 1 p.m.	Healthy	Tuberculous	Doubtful	Remarks
1	Roan	101·2	102·2	101·3	102·3	102·2	1			Bred on farm, 2 years 9 months old, due to calve in May
2	Red	101·2	102·3	104·2	105·4	104·4		2		Irish, purchased in Ireland, July 1895, due to calve in March
3	,,	101·4	102·3	101·4	102·1	102·2	3			Cheshire bred, bought at Crewe, Oct. 1898, in full milk
4	,,	101·3	101·3	101·2	101·2	101·1	4			Cheshire bred, bought at Crewe, Oct. 1898, in full milk
5	Roan	101·2	102·2	100·4	101·2	102	5			Purchased in Ireland, 1895, in full milk
6	,,	102·4	103	102	102	102·1	6			Irish heifer, bought at Crewe, October 1897, just calved
7	Jersey	101	101·2	101·2	102·1	103·3			7	Bought in 1896, calved in December
8	Red & White	102·3	102·3	101	101·3	102	8			Bought 1897, at Shrewsbury, due to calve in April
9	Roan	101	102·1	100·4	101·1	101·1	9			Purchased in Ireland, 1895, due to calve in May
10	Jersey	101·2	101·3	101·2	101·2	102	10			Bred on farm, 2 years 2 months old, due to calve in May
11	Red & White	101·2	101·2	101·3	102	102·3	11			Bred on farm, 2 years old, served on Jan. 18th, 1899
12	Red	101·3	102·1	101·3	102	101·2	12			Bred on farm, 1½ years old, not in calf
13	,,	101	103	103	103·1	106·1		13		Purchased in Ireland, 1895, barren, fattening
14	Roan	101·2	102·1	101·2	102·1	102·2	14			Purchased at Middlewich, 1897, barren, fattening
15	Red	101	101·3	101·1	101·3	101	15			Irish heifer, bought at Crewe, 1897, barren, fattening
16	Red & White	101·3	101·4	101·3	101·4	102	16			Irish heifer, purchased in Crewe, 1895, barren, fattening
17	Bull	100·4	103·3	105	107·1	106·4		17		Purchased in Birmingham, March, 1898, 2 years 3 months old, pedigree, very fine animal, in good condition

Report on Examination of Udders of Cows at Worleston that Reacted.

"Having carefully examined the udders of all the cows at the Dairy Institute, at Worleston, that have reacted, I beg to report that one only, viz., No. 22, has an indurated udder; the remainder, so far as can be ascertained by manual manipulation, being entirely free."

JAMES LAITHWOOD, F.R C.V.S.

Summary.

	At Worleston.	At Agricultural School.	Total.
Number of animals tested	54	17	71
Number declared free from tuberculosis .	37	13	50
,, ,, affected with tuberculosis	14	3	17
,, ,, doubtful	3	1	4
	54	17	71

One udder only found indurated.

Taking, therefore, the Worleston herd, in which were 52 cows and heifers in calf, or in milk, and two bulls, it was found subsequently that all those marked doubtful, except one, were tuberculous. Thus we have 38 healthy and 14 tuberculous, or a percentage of tuberculous animals equal to 27.

This showed the stock to be undoubtedly more free from tuberculosis than what has been stated as the average condition of dairy herds.

In afterwards replacing the animals slaughtered, cattle were only bought after being submitted to the test and not reacting, and of those so tested it was found that of 31 tried 8 reacted or were doubtful, or a percentage of 26.

In each herd the pure-bred shorthorn bull was tuberculous. In the older one at Worleston the disease was deep-seated, and hence the animal must have been affected when purchased some eighteen months before. The younger bull from Holmes Chapel was only very slightly affected. It was determined to slaughter a large number of those that had reacted, and by careful *post-mortem* examination prove the presence or otherwise of tuberculosis, and thus the reliability or otherwise of tuberculin as a means of diagnosing the disease. Hence the animals numbered 6, 8, 17, 22, 29, 30, 36, 55 in the Worleston herd, and Nos. 13 and 17 in the Holmes Chapel herd, were straightway sent to be slaughtered, and the other doubtful ones and those that had reacted were kept for further experiments. The animals so kept were isolated from the rest of the herd, in a separate shippon, specially disinfected before they were placed therein. The whole of the shippons at both places were thoroughly disinfected by means of the Equifex spray.

Results of the post-mortem *Examination of the Animals slaughtered.*

WORLESTON CATTLE.

No. 6. Strong cow, coughing badly. Lungs very much affected, having large caseous nodules with purulent abscesses. Thoracic and mesenteric glands enlarged, and all badly affected. Suprasternal glands enlarged. Carcase inferior, but otherwise apparently healthy.

No. 8. Light roan cow, in good condition. A few tuberculous nodules in the lungs. Mesenteric glands and liver slightly affected. Carcase good.

No. 17. Lungs very much diseased, having a number of old and caseous nodules. The whole of the thoracic and mesenteric glands much affected. The suprasternal glands and costal pleura slightly diseased on the left side. Carcase poor, but not otherwise apparently affected.

No. 22. Mediastinal and bronchial glands all slightly affected. Lungs also tuberculous. Udder contained two large hydatid cysts, but not apparently tuberculous.

No. 29. A very fine handsome roan cow, in excellent condition. The thoracic glands and also mesenteric lymphatic glands all more or less affected. Carcase very good.

No. 30. Roan light-fleshed animal. Only two mesenteric glands were found affected, but very suspicious lesions on right pleura. Carcase inferior, but otherwise appeared healthy.

No. 36. Registered as doubtful, having recently calved. When tested, had immensely enlarged sub-lingual lymphatic glands, which contained purulent and caseous material. The bronchial, mediastinal, and mesenteric glands and lungs slightly affected. Liver extensively tuberculous. Carcase otherwise visibly healthy.

No. 55. Bull, very fine and healthy-looking animal. Thoracic glands affected, mediastinal completely caseated, a number of small nodules in the lungs. Carcase excellent.

Holmes Chapel.

No. 13. A red, good cow, very fat. The whole of the glands in the thoracic cavity were badly affected, and there were several tuberculous nodules in the lung substance. Carcase otherwise very good.

No. 17. Tuberculous lesions were found only in the mesenteric glands. All other organs appeared to be healthy.

Examined by Jas. Laithwood,	Chief Vet.	Inspector,	Cheshire.
Jas. King,	do.	do.	Manchester.
James Storrar,	do.	do.	Chester.

In every one of these cases thus examined the evidence of tuberculosis was so apparent in the animals that no further examination was necessary.

Examination of the Milk.

Samples of milk were sent to Professor Delépine to be analysed bacteriologically, and to be tested by inoculation. In each case specially-constructed and sterilised bottles were supplied, in which samples of the milk were sent. Milk from the following cows was thus tested: 5, 6, 8, 17, 22, 24, 29, 32, 37, 41, 42, with the following results:—

No.	*Microscopical Examination.*	*Result of Inoculating Animals with the Milk.*
No. 5.	No tubercle bacilli found.	No tuberculosis; no sign of disease.
6.	Do. do.	Do. do.
8.	Do. do.	Do. do.
17.	Do. do.	Do. do.
22.	Do. do.	Do. do.
24.	Tubercle bacilli found in a large clump.	Animals inoculated died in five days.
29.	No tubercle bacilli found.	No signs of tuberculosis.
32.	Do. do.	Do.
37.	Do. do.	Do.
41.	Do. do.	Do.
42.	Do. do.	Do.

Thus the milk of none of the animals affected with tuberculosis was found to contain tubercle bacilli, except No. 24, a remarkably healthy-looking animal. This case will be treated separately later on.

Animals retained for Further Experiments.

These, as stated, were isolated from the rest of the herd, and consisted of Nos. 5, 24, 32, 37, 41, 42, 27, 35, 51. Of these Nos. 27 and 35 had been classed as doubtful ones. It was determined to submit these animals to repeated injections of tuberculin, and to watch carefully the results.

Injection on 23rd March, *i.e.*, just a little over six weeks after the first testing on 6th February.

[Table.

TABLE III.

No. of Cow.	Temperature before Injection.	Temperature after, next morning.				
		At 6 a.m.	At 8 a.m.	At 10 a.m.	At 12 noon.	At 2 p.m.
5	101	102	102·4	103	103	102·4
24	101·3	102	102·2	103·1	103·4	104
32	102	104	105·1	106	105	105
37	102·2	103	104·3	104·2	104·1	104·4
41	101	102	102·4	102·2	103·1	103
42	102	103	103·2	103·1	103	103·4
27	101	100·3	102·2	103	102·4	103·1
35	101	101·3	102·3	102·3	102·2	102·2
51	102·2	103·4	103·4	104·3	100·4	103·3

No. 51, a heifer, and in calf, was now turned out into a field to test the value upon her of fresh air, with a view to another test later on after calving. The first six were again tested on 5th April, *i.e.*, a fortnight after the second test.

TABLE IV.

No. of Cow.	Temperature before Testing.	Temperature after, next morning.			
		At 6 a.m.	At 8 a.m.	At 10 a.m.	At 1 p.m.
5	100·2	101·1	101·1	102·1	102
24	101·2	102	102·4	103·1	103·4
32	102	102	102	103	103
37	102	102·3	102·4	103·2	103·3
41	101·2	102	103·3	105·2	104·2
42	101·4	102·1	102	102	102·1

The whole of the animals, except 51, were again tested on 19th April, *i.e.*, at the end of another fortnight showing the following:—

TABLE V.

No. of Cow.	Temperature before Testing.	Temperature after Injection.			
		At 6 a.m.	At 9 a.m.	At 11 a.m.	At 1.30 p.m.
5	101	101·3	103·2	103·3	102·4
24	101·4	103	104·2	106	105·4
32	101·2	102·1	102·2	103·3	104
37	102·2	103·2	104	105	104·4
41	101·4	102	104·2	106	105·3
42	101·2	102·1	103	103·3	103·1
27	102	104·1	104	105	103
35	101·3	101·1	101	102	101·2

No. 27, which had been considered a doubtful one on account of her high normal temperature, gave now a decided reaction, and was henceforth classed as an affected cow; while No. 35, still not reacting, was considered a healthy animal, and no longer tested. No. 27 was sent to be slaughtered, and the result of the *post-mortem* examination was:—

No. 27 had extensive lesions on both lungs, bronchial, and mediastinal glands, liver, inguinal glands, and costal pleura; altogether a bad carcase.

It was considered that the experiments showed either that a larger dose than three centimetres of tuberculin, or more frequent injections than four in ten weeks, were necessary to bring about a state when the tuberculin would cease to cause a reaction in the animal. Hence, on the next occasion, viz: 27th April, 3·8 centimetres of tuberculin were used, with the result that the six animals either did not react at all, or only slightly, as is shown in Table VI.

TABLE VI.

No. of Cow.	*Temperature before Injection.*	*Temperature after Injection.*				
		At 7 a.m.	*At 9 a.m.*	*At 11 a.m.*	*At 12.30 p.m.*	*At 1.30 p.m.*
5	101	102	101·1	101	101·2	102·1
24	102	102	99·4	101·2	101·4	102·1
32	101	102	102	102	102	103·1
37	101·2	102	101·2	101·1	102·1	102·4
41	102	101	101	101·3	102·1	102
42	102	101	101	101·3	102·1	101·4

Nos. 5, 24, and 41 were sent to be slaughtered and examined, and the others kept to see how long they would continue to cease to react on injection. It was now known from the result of the milk analysis that No. 24 was tuberculous and dangerous.

The results of the *post-mortem* examination of the cows sent showed:—

No. 5.—No tuberculous lesions whatever could be discovered, but the liver contained an enormous quantity of flukes.

No. 24 had a quantity of tuberculous lesions of old standing in the lungs and on the costal pleura, the bronchial glands full of pus, the mediastinal and mesenteric glands much affected, and the deep inguinal glands much enlarged. No tuberculous lesions could be discovered in the udder from the naked eye examination, and the whole of the udder was forwarded to Professor Delépine for investigation.

No. 41 had very considerable tuberculous lesions in the bronchial, mediastinal, and mesenteric glands, and a number of caseous nodules in the lungs.

On 17th May the remaining three cows were again tested and showed:—

TABLE VII.

No. of Animal.	*Temperature before Testing.*	*Temperature after Injection.*			
		At 7 a.m.	*At 9 a.m.*	*At 11 a.m.*	*At 1 p.m.*
32	101	101·2	101·3	101	101·1
37	102	103·1	103·3	101·4	101·1
42	102·4	102·1	102·2	101·1	101·2

These animals having ceased to react on 27th April, continued in the same state on this testing, viz.: a period of twenty days. Nos. 32 and 42 appeared to be in excellent health, but No. 37 had evidently lost flesh.

On being again tested on 21st June, or thirty-five days from first ceasing to react, it was found they still remained in the same condition. No. 51, a two-year-old heifer, which, after reacting in February, had been out in the fields for four months, was again tested and found still to react.

TABLE VIII.

No. of Animal.	*Temperatures.*				
	Before Injection.	*After Injection, at intervals as before.*			
32	102	102·2	102	101·3	101
37	104	103	103·3	103·4	102·1
42	102·1	102·1	102·2	102·1	102
51	103	104·4	104·1	104	103·2

These animals were now sent to be slaughtered and examined, and thus reported on :—

No. 32 was only slightly affected, a few tuberculous nodules being found in the mesenteric glands. Carcase good.

No. 37.—No visible evidence of tuberculosis could be detected, but the mammary lymphatic glands were enlarged, and a portion was sent to Prof. Delépine for further examination. He reports "I examined fresh scrapings of these glands, and found them to contain tubercle bacilli."

No. 42.—Bronchial and mediastinal glands and lungs badly affected, mesenteric glands, peritoneum, and liver slightly; a thin carcase.

No. 51.—Mesenteric glands slightly affected; abscess in the liver, otherwise healthy.

Account of Special Cases.

1. Cow No. 5.—It will be seen from Table I. that this cow reacted in February, that the temperature rose to a less extent on 23rd March (Table III.), and did not react on 5th April (Table IV.), but reacted again 19th April (Table V.), and ceased to react again on 27th April (Table VI.), when a larger dose of tuberculin was applied. On its carcase being examined after slaughter no tuberculous lesions could be discovered, but the liver contained an enormous quantity of flukes. It will be noticed that the highest temperature which she obtained was 104 in February, and the irregular temperatures shown afterwards were probably due to the derangement caused by the above-mentioned parasites in the liver, and had no connection with the injection of tuberculin.

A small portion of her bronchial gland was sent to Professor Delépine for microscopical examination, but he reported: "I could not do anything with the small portion of tissue from Cow No. 5. It had got dry, and I could not cut it so as to obtain pieces entirely free from possible contaminations. Positive and negative results would have been alike in respect of their not being conclusive."

2. Cow No. 24.—This is the most important case that occurred. A half-bred Welsh, very hardy and a good milker, she reacted on each occasion when she was tested. Her udder was carefully examined on 2nd March, and found perfectly right so far as could be ascertained by manual manipulation.

On 27th April, after another most careful examination of the udder, no derangement whatever could be detected, although at the time it was known that her milk contained tubercle bacilli.

After slaughter no tuberculous lesions could be found in the udder from the naked eye examination. In this examination of the udder Mr Laithwood had the assistance of other veterinary surgeons. On the udder being submitted to Professfor Delépine for microscopical examination, he reported:—"There was a distinct evidence of the disease of the udder, especially of the left posterior quarter, the main ducts and cistern of which were full of pus and catarrhal cells. The milk contained in the ducts was very abnormal; strongly alkaline, separating rapidly into two layers, upper one-third creamy-looking, lower two-thirds serous, with an abundant sediment. This milk contained a large number of cells and bacteria, chiefly staphylococci and streptococci. In a specimen examined microscopically, no clear tubercle bacilli could be discovered. In the substance of the gland itself no definite tuberculous lesions could be discovered, but the left mammary lymphatic ganglion was much enlarged, and contained a large number of typical tubercles, in which tubercle bacilli were easily found."

"*Results of Inoculations.*—Two guinea-pigs inoculated with the milk contained in the ducts and scrapings of the tissue of the udder died rapidly of septic infection; in the cheesy material remaining at the seat of inoculation tubercle bacilli were clearly demonstrated. One guinea-pig inoculated with portions of the mammary lymphatic gland showed signs of tuberculosis of the glands near the seat of inoculation at the end of twelve days, and in these lesions tubercle bacilli were easily demonstrated. The udder was therefore undoubtedly tuberculous, but there was no focal lesion which could be easily recognised by a naked eye examination."

"I found no lesion which was absolutely diagnostic of tuberculosis, except in the mammary lymphatic ganglion, which could not have been more typical. One quarter of the udder was very much diseased, but this was evident only on opening and following the milk ducts."

"The portion of the lung from this same cow was clearly tuberculous, and contained virulent bacilli, which produced tuberculosis in one guinea-pig inoculated with portions of the lung."

It will be observed from the analysis of the milk of this cow, that it was highly tuberculous (*see* p. 351).

It would appear from this that the examination of the udder by manual manipulation only, is not reliable so far as detecting tuberculous udders is concerned. Also the idea largely prevalent that the milk from a cow having no appearance of a diseased udder is perfectly safe from tuberculosis, is undoubtedly a serious mistake.

Further, that to be perfectly sure that the milk of a cow that has reacted is not dangerous as containing tubercle bacilli, it is necessary to have the milk properly analysed and tested. It is not sufficient to be satisfied with manual manipulation of the udder by even a scientific man. To test a herd thoroughly, it appears to be necessary first to use the tuberculin test to make manifest those affected in any degree with tuberculosis, and then to have the milk of all the reacting animals analysed and tested, to see which must be destroyed at once as specially dangerous, and which may be retained to be separated from the rest of the herd, and fattened and disposed of gradually.

The proportion of specially dangerous animals in the Worleston herd was therefore reduced to one, out of the total of fifty-two, or a percentage of 1·9 against the 3 per cent. generally stated as the average per centage of cows that, having tuberculous udders, are highly dangerous.

Again, Cow No. 22 was reported to have two very suspicious nodules in the udder—one about the size of a hen's egg, the other half the size—hard

and non-painful, and appearing to cause no inconvenience. On a *post-mortem* examination both were found to be simply hydatid cysts.

Cow No. 41.—This cow, having decidedly reacted throughout the first four testings, ceased to react on 27th April, and was then sent for slaughter. This was done to test. whether or not, the tubercle bacilli were virulent in an animal that had ceased to react to tuberculin. The *post-mortem* showed tuberculous lesions, and a number of caseous nodules in the lungs. A portion of the lung being submitted to Professor Delépine, his investigations showed, in regard to these nodules: "The lung contained several typical tubercular nodules, some undergoing softening. These lesions contained tubercle bacilli, which on inoculation proved to be virulent, typical tuberculosis being produced in a guinea-pig in three weeks, and showing already at that date a tendency to rapid generalisation."

Cow No. 51.—A heifer bred on the farm. After reacting on the first two occasions, she was turned out in the fields until after calving, to see if any improvement would result from simply being out in the fresh air. On being tested again on 21st June, she still reacted (Table VIII.) and was slaughtered when the mesenteric glands were found slightly affected.

The result of the fresh air treatment on this heifer points to the conclusion that, although the period of four months was insufficient to bring about a cure, it certainly had the effect of arresting the progress of the disease, a very small amouut of tuberculous lesion being found on *post-mortem*.

Cow No. 15.—This cow, not having reacted on 6th February, and having ceased to milk, was put up for feeding at the end of March. On 23rd March there was administered to her in a quart of water two ounces of tuberculous gland, the object being to determine whether dosing with tuberculous matter would cause tuberculosis, and in what time. On 19th April, *i.e.*, twenty-seven days later, she reacted to the test, giving a well-marked reaction (106·1).

On examination after slaughter the report was: "No. 15 showed extensive tuberculous lesions on the costal pleura, covering a considerable surface, very small nodules at the apex of both lungs, and slight disease of the mesenteric glands, with considerable hyperhœmic condition of most of the lymphatic glands. All the lesions appeared to be of very recent origin. The udder contained three abscesses full of pus, but had not a tuberculous appearance."

The tuberculous lesions in this cow were evidently all of recent formation, and contained no old-standing caseous nodules.

The above experiments show clearly the reliability of the tuberculin test as a diagnosis of the presence of tuberculosis in an animal. The amount of reaction, however, does not appear to be any index to the extent of the disease or the degree of infection. Tuberculin, indeed, is at present the only reliable method of testing for the disease.

Further, it appears that continuous injections of tuberculin at short periods of time will cause reaction to cease in an animal that has previously been shown to be tuberculous.

This points to the great necessity for stringent restrictions being placed upon the sale of tuberculin, and that only duly accredited persons, such as veterinary surgeons, should be allowed to purchase or use it.

Is Tuberculin Curative?

None of these experiments give indication that the injection of tuberculin can be relied upon as a curative agent. It will be noticed that even where the injections were repeated until the animal ceased to give any febrile reaction the tubercle bacilli were still virulent, and Professor Delépine found by

physiological experiment that they produced tuberculosis in other animals after inoculation.

It is doubtful if improvement would have followed after a more prolonged series of injections, but unless tuberculin, or any treatment, effected a cure within a reasonable time, it would be of little practical value, apart altogether from the danger of keeping an infectious animal on the farm. When an animal is proved to be affected, the better plan is, doubtless, to isolate her from the rest of the herd, and to take steps for disposing of her as soon as she can be got into condition for the butcher.

Further, it may be said that the general appearance of an animal affords little if any guidance as to her being affected with tuberculosis. It is only in the advanced stage of the disease when it makes itself apparent in the general condition and appearance.

In a number of cases which reacted, they were animals in good condition and apparently most healthy, and such that any person would have readily purchased them for thoroughly sound animals.

The Cost incurred in Clearing a Herd.

In no case was the carcase of an animal slaughtered so affected with tuberculosis as to be declared unfit for human food. Consequently the carcases were placed in the hands of a salesman, to be disposed of for the highest price they would fetch. Authorities generally give 7 per cent. of tuberculous animals as condemned as unfit for human food, a percentage too high so far as this herd was concerned. As all the cows had been previously carefully valued, as dairy cattle, the loss can be accurately stated, viz.:—

WORLESTON.

No. of Animal.	*Valuation.*	*Amount Realised.*	*Loss.*
5	£15 0 0	£3 18 0	£11 2 0
6	8 0 0	8 0 0	—
8	16 10 0	10 18 0	5 12 0
15	15 10 0	13 4 4	2 5 8
17	18 0 0	12 2 9	5 17 3
22	19 10 0	7 17 1	11 12 11
24	16 10 0	7 14 4	8 15 8
27	16 10 0	7 3 6	9 6 6
29	18 0 0	12 10 10	5 9 2
30	10 0 0	4 14 1	5 5 11
32	20 0 0	13 11 4	6 6 8
36	16 0 0	4 19 11	11 0 1
37	15 0 0	5 4 10	9 15 2
41	19 10 0	7 9 0	12 1 0
42	19 0 0	9 8 4	9 11 8
51	14 0 0	5 1 7	8 18 5
55 Bull	27 0 0	22 1 8	4 18 4
HOLMES CHAPEL.			
13	16 18 6	14 2 8	2 15 10
17 Bull	33 0 0	23 12 6	9 7 6
	£333 18 6	£193 14 9	£140 3 9

Or an average loss of £7, 7s. 6d. per head.

The amount of loss here incurred is exceptionally heavy, owing to the special circumstances under which the disposing of the animals took place. It was deemed necessary, in order to prove the reliability of the test, to follow it up at once with slaughter, no matter what the condition of the animal was. Hence cows that were heavy milkers, and low in flesh, or cows recently calved, incurred heavy losses, as *e.g.*, Nos. 5, 22, 32, 36, 37, 41, 42. Such cows were high in value as dairy cows, and so accounted, but only low in value for sale for food. Indeed, over one half (£71, 9s. 6d.) of the loss was incurred on these seven animals. Such a loss need not be incurred under ordinary circumstances, as the healthy animals can be separated from those that have reacted, and the latter either made fat and sent to the butcher or disposed of at once, as is found to be best and most profitable. An animal that reacts should unquestionably be turned out of the dairy herd, but there is no reason why the farmer should be compelled to sell her until he can do so as profitably as possible. Under such a procedure the loss would not be more than two-thirds of that named above, if indeed so much.

Animals whose milk upon analysis is found to contain tubercle bacilli should be slaughtered at once; on such the chief loss would arise, but the number of such is comparatively small.

The Royal Commission on Tuberculosis, and, indeed, all veterinary surgeons, are agreed that tuberculosis is not hereditary. Two striking examples in testimony of this were produced in the testings. The cow No. 6, which was probably as bad a case as any, is the mother of bull No. 1—a healthy and sound animal of fourteen months old. Again, cow No. 22, which was tuberculous, is the daughter of another cow in the herd who is sound, and did not respond to the test.

Statement showing the Expenditure incurred in carrying out the Experiments.

Compensation paid for cattle slaughtered . . .	£140	3	9
Payments to veterinary surgeons for conducting the experiments and *post-mortem* examinations . .	48	11	6
Payment to Professor Delépine for milk and other analyses	14	14	0
Disinfecting cow-houses	0	17	6
	£204	6	9

Summary.

The following are the leading conclusions that have been noticed:—

1. That tuberculin is a reliable and safe test for diagnosing the presence of tuberculosis in an animal.

2. That it does not afford any index of the extent or degree of the disease.

3. That testing with tuberculin has no deleterious effect upon the general health of the animal, and also will not propagate tuberculosis in a healthy animal.

4. That manual manipulation only of the udder is not sufficient to decide whether the milk from an infected animal is tuberculous.

5. That an analysis of the milk of all reacting cows should be made, to ascertain whether they are specially dangerous as having tubercle bacilli therein.

6. That repeated injections of tuberculin at short intervals will cause a tuberculous animal to cease to react.

7. That severe restrictions should be placed upon the sale of tuberculin, so as to prevent its use by any but duly certified veterinary surgeons.

8. That whether tuberculin has any curative effect has not been sufficiently

tested in these experiments to make any generalisations thereon, but the results so far obtained point otherwise.

9. That the number of animals affected with tuberculosis is not so great as has been stated, and the percentage of those so affected giving tuberculous milk is also not so high as generally put forth.

10. That the healthy appearance of an animal is no index to its being free from the disease.

(Signed) C. E. THORNYCROFT, Chairman of Technical Instruction Committee.

RD. P. WARD, Organising Secretary to Technical Instruction Committee.

RESOLUTIONS PASSED BY THE SEVENTH INTERNATIONAL VETERINARY CONGRESS.

I. International Veterinary Sanitation.

THE Seventh International Congress considers it useful and desirable, both in the interest of the several States and on general economic grounds, that the contagious diseases of animals should be combated by the uniform application of scientific principles, as well as by the appropriate regulation of veterinary matters, an intelligence department regarding outbreaks of epizootics, and international traffic in cattle. But, having regard to the differences which at present exist between the various countries in the matter of economic development and commercial conditions, and also to the want of uniformity in the organisation of a veterinary service in the different countries, the Congress does not consider that the time has yet come for laying down definite principles for an international agreement.

II. The Prevention of Foot-and-Mouth Disease.

In order to combat foot and mouth disease it is desirable:

1. To pursue by all possible means the scientific investigation of the disease.

2. To prohibit the importation of cattle from districts in which the disease occurs.

3. That the traffic in cattle should be submitted to stringent veterinary supervision, and that animals belonging to cattle dealers should be subjected to veterinary inspection before sale.

4. That the skimmed milk and other residues from public creameries should not be returned until they have been submitted to a temperature which can be relied upon to destroy the agents of infection.

5. That in appropriate cases authorities should be empowered to slaughter with compensation.

6. That the introduction and execution of the necessary sanitary measures, prominent among which are quarantine and disinfection of the clothes of attendants, should be uniform over the whole of the country.

III. Meat Inspection.

1. The Congress calls the attention of the Governments of the various States officially represented to the necessity of introducing compulsory meat inspection.

2. Only qualified veterinary surgeons should be appointed as meat inspectors, or as directors of slaughter houses or cattle markets.

Where the services of such qualified veterinary surgeons are not obtainable, other persons with limited powers may be employed as meat inspectors. Such persons should be trained, as far as possible, in large slaughter houses by veterinary inspectors. They ought to be submitted to examination by the State, and they must always be under the control of veterinary surgeons.

3. Instruction in meat inspection should be included in the course at all veterinary institutions.

4. Meat inspection ought always to be based on scientific principles which have been justified by experience, and regarding which it is desirable to arrive at an international understanding.

5. Meat inspection must be carried out in every part of a country, and extend to all the species of animals slaughtered for food purposes. It must extend to all slaughtered animals and to all flesh intended for human food, whether the same be for public sale or private use.

6. Public slaughter houses are necessary for the efficient carrying out of meat inspection. It is therefore desirable that they should be erected wherever possible.

7. With respect to the inspection of imported carcases of animals slaughtered elsewhere, it is necessary:

(*a*) That the carcases of cattle and horses should be introduced in quarters, of swine in halves, and of all other animals in the undivided condition.

(*b*) That the principal organs should be left in their natural connection with the carcase.

(*c*) The importation of preserved meat from abroad shall not be permitted unless the method of preservation is unobjectional from a sanitary point of view, and the non-injurious character of the meat can be determined with certainty.

8. Meat which is passed as fit for consumption ought to be marked in some convenient way.

9. Flesh which, although not injurious to health, is of low value, ought to be sold with a declaration and under supervision of the authorities (Freibank).

10. The introduction of a system of compulsory general cattle insurance under State control is very desirable in the interests of meat inspection and of the suppression of animal plagues.

11. Both from a scientific and an economic point of view it is desirable that statistics with regard to the results of meat inspection should be published according to a uniform plan arrived at by international agreement.

IV.—Prevention of Tuberculosis among the Domesticated Animals.

The Seventh International Veterinary Congress declares:—

1. That it is absolutely necessary to combat bovine tuberculosis.

2. The voluntary method of dealing with the disease is practicable, and ought everywhere to be encouraged. It requires the early slaughter of dangerous tuberculous animals, and the careful prevention of infection of calves and healthy cattle.

The State ought to encourage the voluntary method of dealing with bovine tuberculosis by disseminating correct views regarding the nature of the disease, its methods of infection, and the importance of the tuberculin test, and also by financial assistance.

In dealing with the tuberculosis of the domestic animals tuberculin is the best diagnostic agent at present known. The use of tuberculin ought to be controlled by the State, and it ought to be supplied to veterinary surgeons only.

3. It is very desirable that the State should undertake to deal with tuberculosis of cattle. With the exercise of a certain amount of care this is practicable, and it would tend to a gradual suppression of the disease.

This would require the prompt slaughter of dangerous animals (especially those affected with tuberculosis of the udder, uterus, intestine, or lungs), with State compensation.

The return of skimmed milk from public creameries in the unsterilised condition ought also to be forbidden.

Veterinary surgeons ought to be required to notify cases of tuberculosis occurring in their practice.

V.—The Use of the Flesh of Tuberculous Animals.

1. Professional meat inspectors ought to be required to adopt a definite method of examination of slaughtered animals, so as to ensure the discovery of every case of tuberculosis, and to determine in every case the extent of the tuberculous process.

2. The most important object of meat inspection is to discover and destroy tuberculous organs and their appendages.

3. With regard to the flesh of tuberculous animals, regions containing tuberculous lesions, limited by the corresponding lymphatic glands, are to be treated in the same way as tuberculous organs (provided there is no doubt that the disease is actually localised to a definite region).

When the tuberculous lesions in the carcase are confined to its lymphatic glands, the muscular tissue may be sold in the sterilised condition after the bones, joints, lymphatic vessels, and lymphatic glands have been properly cut out. In fat animals it is also permissible to use the fat around the tuberculous lesions after it has been melted.

4. In the case of local tuberculosis, and of a generalisation which has been limited to the viscera, the flesh may be passed for sale in the raw condition. If the visceral lesions are extensive the flesh must be sold with a declaration.

5. The entire carcase, with the exception of the melted fat, is to be condemned as unfit for human food when there is emaciation, or when there are signs of recent blood infection (swelling of the spleen and of the whole of the lymphatic glands, with miliary tubercles in the lungs, liver, spleen, or kidneys).

6. In those cases in which the local character of the tuberculosis and the harmlessness of the flesh appear doubtful (especially when tuberculous caverns are present and general nutrition has begun to fail), the whole of the carcase must be sterilised before it is sold.

7. The sterilised flesh and the melted fat are to be sold with a declaration.

VI.—The Use of the Milk of Tuberculous Animals.

1. Cows, goats, etc. kept for the supply of milk should be subject to regular veterinary inspection.

2. The sale of milk from tuberculous animals is to be forbidden when the animals are emaciated or affected with tuberculosis of the udder.

3. Emaciated milch animals, and those affected with tuberculosis of the udder, must be separated from other milch animals, and slaughtered with compensation.

VII.—The Prevention of Epizootic Diseases of the Pig.

1. It is necessary to combat the epizootic diseases of the pig, and measures to that end should vary in the case of the different epizootics.

2. Measures directed against swine plague and swine fever should mainly consist in the slaughter of diseased and infected animals and in disinfection of premises. Slaughter is especially to be recommended for districts into which either of these plagues has been only temporarily introduced.

Methods of protective inoculation, which have not yet been sufficiently proved in practice, are advisable only in districts in which numerous outbreaks have already occurred.

3. In the case of swine erysipelas, in addition to ordinary sanitary regulations, protective inoculation, under the supervision of the authority, of all the animals in the threatened piggeries, is the best means of prevention.

It is also advisable to impose compulsory inoculation where swine erysipelas breaks out yearly in a piggery.

ROYAL VETERINARY COLLEGE, LONDON.

INAUGURATION OF THE WINTER SESSION, 1899-1900.

THE Winter Session at this Institution was opened on Monday the 2nd October last, the introductory address being delivered by Professor Sims Woodhead, of Cambridge. There was a very large attendance, including, besides the staff and students, a number of Governors, and many former graduates of the College, and other members of the veterinary profession.

At the outset of the proceedings the Chair was taken by Veterinary-Colonel DUCK, C.B., Director General of the Army Veterinary Department, who called upon Professor Woodhead to deliver the address.

PROFESSOR WOODHEAD, who, upon rising to address the meeting, was very warmly received by the students and others, spoke as follows:—

"Mr President and Gentlemen,—When my old friend, your Principal, invited me to deliver the annual introductory address before your College and Council—great though the honour—I was sorely tempted to plead that I was too busy to think of preparing any address worthy the occasion. It then struck me, however, that perhaps it was well that some of us should meet in a relation somewhat different from that which we usually bear to one another in this College, and that for once I—not you—should do most of the talking, thus allowing you an opportunity of bringing to bear such criticism as you may wish to make—the results of which, if not so immediately manifest in the examination list, might still be of as much use to me and others as I fancy some of my criticism must be to some of you and your prospective patients.

"For many reasons, however, my task should be light, the most important being that since my undergraduate days I have been so closely associated with many of those—from the student to your Principal and Professors—who have done such admirable work in your profession, that I ought to be able to discourse for hours of the work you are doing and of the practical and scientific outlook of the veterinary profession. But, gentlemen, that very intimacy is the commencement of a serious difficulty, for it affords me the assurance that your interests and affairs are guided and guarded by men who would be able to give you far more valuable advice on many points than I can possibly be in a position to give. My one claim on you for a consideration of my words must be that I can approach the question from an outside standpoint—that I am, as it were, in the position of an onlooker, and that at no point can merely personal interest (in the professional sense) come in to bias my judgment.

"In saying what I have to say I speak merely for the honour of our science, for though our patients are not the same, and our methods may in certain features differ, the principles that underlie the prevention, diagnosis, and treatment of disease—whether in man or beast—are essentially and fundamentally the same. That this is the case is evident from the fact that as our knowledge of disease has advanced, our methods have approximated much more closely than in the early days of medicine. It has sometimes been said that the doctor who has to diagnose and treat disease in the

human subject enjoys great advantages over the veterinary surgeon who has to treat a patient unable to express in words the pains and symptoms that oppress him.

"Now, is this really the case? As we get to know more of disease we gradually come more and more to minimise the importance of subjective phenomena and to rely more fully on accurate physical diagnostic methods. The physician who has to treat the young child is in the same position as the veterinary surgeon, but if we refer to the literature of medicine we shall find that in no department have greater advances been made and diagnostic methods better applied than in children's diseases, and our best physicians are undoubtedly those whose early training has consisted largely in the diagnosis and treatment of disease in children—they are more self reliant, more accurate, and have a wider knowledge of those small but important points from which inferences may be drawn, than are those who have had no such training. Every physician knows how greatly to be distrusted are the so-called subjective phenomena of disease—they are certainly not necessary to precise diagnosis, whilst the man who relies upon them has usually a tendency to carlessness and to accept and treat symptoms in place of finding out the pathological lesions, upon a knowledge of which, only, can any permanently successful diagnosis be made and treatment be carried out.

"Gentlemen, from the scientific and practical point of view you have the advantage. When a patient comes before you you may ask your questions but you must answer them yourself, you are thrown entirely on your own resources, you must rely upon your own methods and upon your own motherwit—trained or untrained. To you the thermometer, the sphygmograph, the microscope, and the test-tube are not merely playthings or for outside display. The results obtained from them must, along with your observations, be the only foundation on which you can build, and it is for this reason I say that you, as a scientific profession, have the advantage over us. Such being the case, how much more important is it that before you go out to take up your life's work you should avail yourselves of every opportunity of fitting yourselves to do your work scientifically and accurately. You are not here merely to learn routine work, you are here to prepare yourselves for the practice of a great profession, to be trained in scientific methods, to learn how to handle patients, the principles of your practice and the principles of treatment; not to go out into the world with heads crammed full of statistics and details, but with a knowledge of how to observe, how to reason on your observations, to find out what the conditions of disease are, and what inferences as regards treatment you must draw when your observations are complete. It is for you to be able to interpret statistics, not to remember them, to compile and reason from them, not to be mere receptacles for them.

"Then with the physical signs of disease—you are not simply to have a catalogue of them on the tablets of your brain, you should be able to picture in your mind the pathological processes that their presence indicates. The symptom is nothing but an indication of the processes that are going on beyond the reach of your direct observation. A physical sign is an outward manifestation of something going on within the body. It is your work, by the use of those signs and symptoms, to draw up for yourself a picture of the diseased organs within, of the alterations in function and in structure that have gone on from the first, and to determine in your own mind the probable further course of the disease; whether you can by any means in your power stay the process of disease, whether it is possible to bring about any resolution of the diseased portion, cause its absorption, or put the patient into such a condition that the diseased part may be gradually cut off from the surrounding tissues, whether there is sufficient vitality in the tissues to make good or repair the damage done to them. All this and more must you be

prepared to reason out and apply, if you are to be a good veterinary surgeon. Let me give you an example, a simple one, but one which shows you how interdependent organs and processes are one upon another, and how necessary it is that the whole history of a disease should be taken into consideration when we are diagnosing and treating it.

"In every septic or infective disease poisonous substances accumulate in the blood coursing through the minute blood vessels which supply the various important organs and tissues of the body, and exerting a very definite influence upon these structures. In a case of pneumonia or inflammation of the lungs especially, where there is acute fibrinous exudation into the air vesicles of the lung, such as occurs in certain animals and under certain conditions, we are apt to look upon this local consolidation as being the only, or—as it is temporarily—the most important lesion in the body. Should the patient die, there is, of course, the coagulated fibrin in the air vesicles, there is also a layer of fibrinous lymph on the outer surface of the lung, showing that the process is not confined entirely to the air vesicles; but above and beyond all this, if we examine the liver, we shall find that it has undergone certain special changes, and that, under the microscope, we have evidence that the liver cells have been poisoned by some toxic substance, as a result of which their protoplasm can no longer do its work properly. If we pass now from the liver to the heart we shall find that we have evidence of a similar change—the heart muscle has been poisoned; it is working at a disadvantage. This poisoning of the heart muscle often leads directly to heart failure and the patient succumbs, not because it has not sufficient lung surface left for the purpose of oxygenating the blood, but because the heart in its damaged condition is unequal to the task of propelling a sufficient amount of blood through the obstructed vessels of the lungs to allow of circulation going on properly, and ultimately owing to the continued deterioration of the heart muscle it fails entirely and the patient dies.

"How important it is to remember this condition of the heart in such a case may be gathered from the fact that patients suffering from inflammation of the lungs, when apparently well on the road to recovery, suddenly collapse if they are called upon to undergo any slight extra exertion. All the exudation from the lung may have been absorbed, but the damage to the heart has been great—the poisoned muscles have undergone a kind of fatty degeneration, and until these fatty fibres have got rid of the fatty substance and have resumed their normal characters of contractile muscle, or until the old fibres have been absorbed and new ones have taken their place, the heart is not equal to the strain, it gives way, and the patient succumbs.

"The man who knows this when he goes into practice, knows how to safeguard the interests of his clients. He points out how the digestive processes, associated with the functions of the liver, are going on but feebly, and diets his patient accordingly; how the heart is weaker than usual, and so rests his patient and regulates its exercise to allow of a gradual restoration of strength before he puts on any strain upon this organ that would do it damage. I might multiply examples indefinitely, but I simply wish to point out that if a man will attend carefully to his instruction in the College, he will gather knowledge in a week which may be as valuable as years of experience, and he will start his professional life with principles which enable him to commence where his predesessors have left off.

"Gentlemen, whilst you are studying here I beg you to follow most closely the teaching of your Professors. It is sometimes said that it is a good thing for a young man to take the bit into his teeth and follow his own bent, his own line of thought, and go his own pace. If each one of us had to start life with a trained mind we might have taken such a course with impunity; but in that case it would not be necessary for us to come to any College to be

guided in our work. Much of what you learn here may, nay, must necessarily, in time pass out of your minds. Further, each one of you must be quite prepared to find when you come to look into matters for yourself, that you will not always find yourself in agreement with some of the teaching now given by your Professors; and this for two reasons—first, because by the time you come to think deeply and widely for yourself new light may have been shed on the subject, new light from various sources, by means of which much of what is now in deep shadow may be more fully illuminated. This should be no cause for self-congratulation—except that the additional light has been provided for your use—nor, on the other hand, should it ever be allowed to encourage a single thought of disparagement of the learning and accuracy of your teachers, who have to form opinions and give judgments under conditions of difficulty and uncertainty of which you necessarily can then have but a faint idea. The second reason that you will have for not agreeing with some of the teaching that you have received, and will receive under this roof, is, that if you are worth your salt as practitioners, and give your brain the whole benefit of the advantages open to you here, you must necessarily develop some individuality and some original mode of looking at the subjects in which your life's work and interest will lie. You should add some new observation, offer some fresh interpretation of old observations, throw light into some dark corner, or contribute some epoch-making discovery, which you may say is all your own, but which the world will say you share with those teachers whose knowledge you may imagine you are superseding.

"Remember that here you are first digging down for a sure foundation, and that only when that is firm and well prepared can, or should, you commence to build up the superstructure of a life's work, well done and beautifully finished.

"Why should I insist on these differences of opinion that may arise, and draw attention to the almost kaleidoscopic change of knowledge? Because I wish to call your attention to one part of your work here, which if well and carefully done can never be useless, and will always remain with you. The principles that are here offered for your acceptance, for the guidance of your work, and for the acquisition of knowledge, are the outcome of the experience of many generations of workers and teachers. They are the foundation on which you will pile up observations and facts, whilst the methods into which you are here initiated may be looked upon as the scaffolding on which you must mount in order to rise with, and beyond your building.

"Here the foundation and scaffolding prepared for, and offered to you are good and sound, and it will be your own fault if you do not take your share in getting down to the bed rock for acquired truth for your foundation, and then in binding and staying the scaffolding of methods into a good temporary support for the lower storeys, at anyrate, of your professional work. With a scaffolding well begun, it is easy to make additions as your building grows, but with a shambling scaffold no good building can be done, and no further stable scaffold, by means of which to carry our building higher, can rise.

"I do not wish to be tedious, but I cannot refrain from taking, as an illustration of what I wish to bring under your notice, a concrete example.

"In recent years Metchnikoff, by his brilliant work on phagocytosis, has drawn attention to one of the processes observed in inflammation in such a manner as to make some people believe that phagocytosis and inflammation were practically convertible terms. If you read the recent literature on the subject of inflammation you will be astonished to find that in all probability your Principal—I ask his pardon for using this illustration—

will devote perhaps less than one-sixth of the whole of his lectures on inflammation to phagocytosis. If you think too much for yourself (I mean in the conceited sense) at this period, you will wonder why this great present day question of phagocytosis does not receive more attention. If, however, you will keep your thoughts to yourself until the lectures are completed you will probably never express them at all, for you will find that since John Hunter's day and since Waller, Wharton Jones, and Cohnheim made their wonderful contributions to our knowledge of the behaviour of the white blood corpuscles in their passage from the blood vessels into the surrounding tissues, slight additions to our knowledge of the subject have from time to time been added. Cohnheim's foundation was so sure that although these additions have filled in gaps, and have helped to round off our knowledge of the process as a whole, little or no essential modification of the work that he did has been necessary, or even possible. Now your Professor knows all this, he has passed through the mill of his reading and experience all that has been written and the work that has been done in connection with inflammation. He has made his own observations on his patients, has performed experiments, and has had many natural experiments performed for him, and as the result of much probing, sifting, and arranging he has been able to select what is worth studying, to lay stress on important points, to build up, as it were, for you a picture of inflammation which will serve as a basis for your future work, and which you yourselves could only have arrived at after years of careful study.

"He will tell you that it is impossible to take any one special tissue or function and allow it to arrogate to itself the credit of being the seat of, or the cause of the whole process of inflammation. It is well that those who make new observations and start new theories should be enthusiastic and, shall I say, a little over-sanguine or even one-sided. The things which are near to us and which we study most thoroughly and carefully are apt to block out from our view other important, perhaps more important, matters. Further, it must be remembered that the side of a house to which we stand close will block out the view of a whole country side, and even of a mountain the size of Mont Blanc, though from our early experience and acquired knowledge of perspective we are not misled. When we come to matters scientific, however, our knowledge of true perspective is at first nil, and it takes a long time for us to acquire an accurate working knowledge thereof. Until that is acquired it is well for us to trust those who have given their lives to its study.

"Remember, moreover, that you will be assailed from all sides by men who have worked carefully, each in his own little patch of ground, who will tell you that the products of his garden are the only ones worth gathering. Do not believe them. Accept what each has to bring, put it through the mill as you have learned from your Professors to do, and then add it to your store of knowledge, fit it into its proper place in the scheme that you desire for your mental discipline, or if you find it worthless, throw it aside altogether. We have seen that in inflammation certain people tell you that phagocytosis is everything, others that without chemiotaxis there could be no inflammation, others that damage to the tissues is an essential—others that only when you have a process of proliferation and repair can their be inflammation. You will find that all these factors enter into the question. Each has its importance, each plays its part, but you cannot say that any one is all important in itself, or even is a necessary part. The exaggerated importance given to each factor arises out of the fact that many of the processes have been studied on simple protoplasmic bodies, in which as yet there is but little specialisation of function. It is assumed that because certain amæboid or even organisms slightly more specialised behave in a certain fashion when they are exposed to the action of irritants, that, therefore, cells which in the

higher animals have a similar appearance and perhaps also to a certain extent similar functions must do exactly the same thing when they are irritated. That is only a half truth, but it has so specious an appearance of whole truth that it may deceive the unwary. It must be held that inflammation occurring in the higher and more specialised is a more complex process than it can be in the less specialised form of animal life. Indeed in the less specialised animal we can scarcely expect to find more than a very small part of the process which we recognise as inflammation in the higher animals, all of which have well developed blood vessels. In these vessels are coursing red and white blood corpuscles suspended in a fluid of definite composition. Around these vessels are tissues of various kinds (muscle, nerve, etc.), and in all of them are channels and connective tissue cells and spaces. All these have to be nourished, all are the subject of various kinds of stimulation, all have to get rid of effete matter, and any or all of them may at any time be impaired. Even under normal conditions dead tissue has to be got rid of, whilst much more is this the case when tissues are injured, mechanically, chemically, or the like, and new tissue or some substitute has to be developed to take the place of that which was lost. In certain of the simpler cells many of these processes, normal and abnormal, may be seen going on, and sometimes we think we understand how they go on, but in the more complex animals in which we have to study these processes we can only guess at the modes in which such processes are carried on—we cannot see any of them. We may know something of the actual resulting products, but beyond that, learnedly as we may talk, our real knowledge is still very scanty. Certain processes that are observed in inflammation of the higher animals then, so far as we can determine by our observation and analysis of results, are seen to be analogous to certain of the processes observed in simpler animals and cells, but it would be a dangerous matter to conclude that the part, or even collection of parts, seen in the lower organism is equal to the whole of the complex process inflammation as presented in the more highly developed organism.

"The vessels then with their red and white cells, these latter of various form and function, give us something quite different from anything that occurs in the non-vascular animals. One of the essentials of acute inflammation is a process of passage outwards into the surrounding spaces or tissues, first of the fluid in the vessels and blood plasma, and secondly of the various colourless and red blood corpuscles, the former not only giving rise to the round cell infiltration that we see, but in all probability along with the minute blood platelets breaking down to combine with certain elements of the blood plasma to form fibrin.

"Here then we have a something which does not, as far as we are aware, occur in the lower forms of animal life. Beyond this, however, we have a series of proliferative changes which are so wide spread in inflammation, and can be so readily watched, that they are well worth careful consideration. Not only do the wandering cells or leucocytes proliferate, but in a much more marked degree, the fixed cells that enter into the constructive process of building up connective tissue, whilst there may also be seen distinct enlargement, and then proliferation of the specialised cells composing the endothelial lining of the blood and lymphatic vessels. In addition, we have the changes that take place in the more fully specialised tissues, so that it may be gathered that inflammation, however fundamentally simple it may be, is an enormously complicated process when it comes to us, and not to be studied in any one of its branches alone.

"This, gentlemen, is a simple example, but you will find that the same truth holds good, whatever branch or part of your professional study attracts your attention and demands the expenditure of your brains and energy in its study.

"One of the great advantages, gentlemen, that you now enjoy is that you enter your profession with a preliminary training that many of your predecessors were not compelled to go through. The Royal College of Veterinary Surgeons insists that those who are to take its diploma shall receive an education which will enable them to profit from the teaching offered in the Colleges; and, gentlemen, although there may be no greater giants in the profession now than there were in days gone by, since the standard of preliminary education has been raised, there are certainly far fewer pigmies, and the general stature has, even in my limited experience, risen enormously. The outstanding men of to-day had their counterparts in the outstanding men of the last generation and of all early generations, but the average power of the profession has never been so great as it is to-day.

"I have sometimes been told, by those who maintain that there were no days like the old days, that it is a mistake to ask for such a high standard of scientific knowledge from the man who is going to be what is called a practical veterinary surgeon. We are told that men cannot handle a horse now as they used to, that they have not the same knowledge of his points, and that their practical treatment of his diseases is not what it was. Now, gentlemen, I for one do not believe this. That he does not devote so much of his time to the breaking-in and management of horses, to the blistering, cupping, and setoning of horses, I may agree, but beyond that I cannot go. The man who is going into the country, to be away from contact with his fellows and from those who are engaged in scientific work, is the very man who should have his foundations sure and his training thorough, for in after-life he is to be thrown entirely on his own resources, and unless he makes the most of his college training there is only too great danger that he will settle down to an early professional life of blunders and losses, and, when experience comes, to one of dull routine and *laissez faire*. The science of veterinary medicine and surgery is now so far advanced that not only are practical veterinary surgeons required, but men expert in all that relates to the prevention and treatment of disease. Such men must be trained for the public veterinary service, they have places to fill which are now imperfectly filled by other men, and they have a work to do which can be done by them, and by them alone. To such men the training given during the four years' course in your colleges is essential, and those who are to do the highest work will find that, hard as they may work during this period of four years, they have still much special training to go through before they are fitted to undertake the duties that will devolve upon them. Many of you will specialise in some direction in later life, but all will find that a combination of the scientific and the practical, such as they obtain during their course here, will be essential to their professional success. Even in what is called practical training in the profession, how much more can be taught in a short time, where the best methods are selected and the teaching of them is systematised, than under the old system of pupilage under men of whom, perhaps, only one in five had any special information to impart, and only one in ten of these was able to impart it. Of course I fully appreciate the fact that a man's future career must, to a certain extent, depend upon his very early training, and that, other things being equal, a lad who has been brought up amongst horses, whose knowledge of them grows as he grows, who is with them during the most receptive and impressionable years of his life, will make a better practitioner than the man who has only had his college training, and who has only come in contact with animals during this period; but if I am asked to commit a horse of mine to the care of the well-trained college student on the one hand, or to the so-called practical man, who has wasted his time at college or who has neglected his principles in order to devote more time to his practice, on the other, I should have no hesitation as to which I should select. I distrust the man who knows every point of a good horse, but diagnoses disease at sight; but if, in addition to knowing a good

horse when he sees him, he starts methodically and systematically to overhaul the animal, to examine him thoroughly, and gives evidence that he has a knowledge of disease generally, then I feel that I am in safe and competent hands, and I know that what can be done will be done. Such men, now, fortunately, are common, men who love animals, who have acquired a control over them, who, in addition, have acquired methods and a scientific groundwork which may be developed later, either into the capacity for treating disease, or, what is more important still, preventing it.

"I have a theory in regard to the men of my own profession which, I think, might apply with equal force to yours—that is, that the best men in the profession will learn anywhere, that the worst are practically hopeless, and will learn nowhere, but that the success of the average man depends, to a very large extent, upon the nature and extent of his early and professional training. You know that different schools are characterised by different methods—that one insists upon its alumni being thoroughly well educated to begin with, and then, whilst compelling them to devote a certain amount of time to what may be called the art of the profession, lay very great stress upon a thorough training in scientific methods of observation and logical methods of induction and deduction. Another school insists that, as a man is to be engaged in the treatment of disease, he should devote the greater part of his time to the practical observation of disease in the wards, and to familiarising himself with the drugs, instruments, and apparatus by means of which disease may be combatted. I have carefully watched the careers of the average men from these two sets of schools, and have observed that, for a year or two, the so-called practical man appears to get ahead of his more scientific compeer. He has more *nous;* his patients have more confidence in him, because he seems to be familiar with the means of curing; but at the end of five years there is no comparison between the two men. The man who began well has lost nothing, has perhaps even gained ground—he has five years' experience at his back; but the man who had only his practical work to learn has now learnt it, it is for him a means of bringing to bear on diagnosis and treatment methods which he is satisfied from observation, deduction, and induction are necessary for the welfare of his patient or his client or the public; he not only knows what the lesions he has to treat are, he knows how they are brought about, what their cause is, and how they can be prevented; he not only treats and safeguards the individual patient, but he takes measures to prevent a further outbreak, he takes a wider view of disease, and therefore, ultimately, is by far the most successful practitioner. If a man's principles and methods are sound and scientific his practice is soon perfected, whilst if these be faulty or absent there is far too great a danger that practice may become mere routine. As Sir Michael Foster said at the Meeting of the British Association the other day, scientific men may be commonplace and our methods merely founded on common-sense, but, gentlemen, science is a glorious temple built by commonplace men and of commonplace materials. Unfortunately, as we build, each in our own little corner, we are apt to keep our eyes immediately in front of us, and to think that our own little piece of wall is the most important in the building; we forget the gloriously solid foundations laid down by those who have gone before us, and without which our building could not have reached its present height. Some, again, when they have contemplated their own work, are so engaged in looking down on what has been done that they have no time to contemplate the possibilities of raising a still more beautiful superstructure on what has been already built; they think it is time to put on the roof, because they are convinced that all obtainable knowledge has been crowned in our time, or, at anyrate, to forget that times may come when our building shall appear a mere foundation of a grander edifice than we can yet conceive.

"It is only such men as Darwin who have the power of seeing how small

their apparently great work may appear in the future. He writes: 'What a science natural history will be when we are in our graves, when all the laws of change are thought one of the most important facts of natural history.' His own great work, which produced a revolution in the scientific world, was, with him, as nothing except as a foundation on which future great workers might build. From our point of view some of Darwin's analogies and contrasts could not now be accepted, but that does not render his work any the less valuable. He had to grope in a bosky wood in which there were few paths by which to travel, and few openings by which light could find its way; but he made paths for his followers, and clearings through which light might come, and if we do not follow all his paths, it is because of the light that he has allowed to break upon them. For example, in defining his 'struggle for existence,' Darwin drew a distinction between certain epidemics which he attributed to the great increase of the number of species confined within a small area and the epidemics due to parasitic worms. In the latter case he maintained that there was actually a struggle for existence going on between the parasitic organisms and their hosts; whilst in the case of the epidemic due to crowding, he maintained that the principles involved were probably not of the same character. We now know that in both cases there are parasitic organisms at work, and what applies in the case of one must also apply in the case of the other; we have merely a difference in the size and nature of the parasitic organisms. In the one case we have the large animal parasites —worms, etc.; in the other, small vegetable parasites—bacteria, micrococci, and the like; and so, as knowledge extends, details have to be altered, and anything founded on inaccurate details must necessarily fall, but the great principles and theories founded on accurate observation must ever stand as monuments of the work that has been done and as foundations on which future generations may build with confidence. Tradition that will not stand the light of present day observation must go by the board; but let us not be blinded by a too close and continuous application of our mind's eye to what is simply before us. It is well at times to withdraw ourselves from the present—to think over the past, to speculate on the future, and to see what relation the observations of the present bear to these. Only thus are we able to appreciate the way in which great minds evolve their theories and show any tangible results of their speculations. The subject is a fascinating one, gentlemen, but it would take too much of my time and of your patience for me to go further into it.

"There is one subjeet on which I should like to say a few words, as it is one on which I feel peculiarly competent to express an opinion. We are essentially a practical people. I have recently been travelling in countries from the peoples of whom we have much to learn, but who come to us for information and guidance whenever any practical measures have to be taken for dealing with disease, even when we are under a deep debt of obligation to them for light and information as to the causation of disease. It strikes me, however, that in certain matters we do not exhibit that practical spirit in anything like the degree that we ought to expect, and I will take three examples as texts from which to preach, and which may afford food for reflection to many of us. They are of especial interest to many of us.

"For years swine fever has been a scourge amongst us. We have had an elaborate system of inspection, of central examination, and of compensation. But how far have we been successful in coping with the disease? Now, I do not know whether my veterinary friends will agree with me on some of the points that I am going to raise, but I am looking at the matter as an outsider, and I shall be quite open to correction on any points of detail. I believe that we are going the wrong way to work to get rid of the disease. Into the question of compensation I scarcely feel competent to enter, but I cannot help thinking that this permanent system of compensation has something to

do with the continuance of the disease amongst us. At present, if the disease breaks out in an area the farmers are sure that their loss will not be borne entirely by themselves; and even the best of men have not the same stimulus to exert themselves to adopt preventive measures, when they are assured of certain compensation, as if they were to feel that they would inevitably be involved in considerable loss if the disease should break out amongst their swine. Some temporary system of compensation might no doubt be just, but it should be for a period only sufficiently long to enable effective measures to be taken against the spread of the disease. In the matter of inspection, however, I hold that at present, where such enormous capital is at stake, we are making a grand mistake. I do not for a moment wish to hint even that the men who are at present doing the work are not capable of carrying out the orders that are given to them. They are, no doubt, an intelligent set of men, honourable, active, energetic, but the work that they should be called upon to do is not that for which they are fitted. For administrative and secretarial work, keep them in their present positions, but for the actual inspection of buildings, of animals—whether dead or alive—I maintain that no one but a thoroughly qualified veterinary surgeon should be employed, and this for many reasons. Only a veterinary surgeon can understand the disease thoroughly in its many-sided aspects. The symptoms, the lesions and the like, are not always the same, and an inspector may be years before he sees every lesion and appearance that may be present in such animals, and during the time that he is gathering his experience the latent and irregular forms of the disease are centres from which infection may be spread broadcast. An inspector who has been brought up as a soldier or in some civil occupation not associated with scientific work, can have little knowledge of the principles of infection and disinfection, of hygiene and the like, by means of which only can the disease be prevented. He cannot keep himself *au courant* with most of the recent discoveries as to the pathogenesis of the disease, he must always be behind the veterinary surgeon and *never* so completely equipped. More than this, what inducement has the ordinary inspector to get rid of swine fever? He has been taken from his previous occupation to stamp out a disease by the disappearance of which his present occupation would be gone. I do not say that this can weigh with the bulk of men, but there are always a few men in whatever sphere of life one moves with whom an inducement of such a kind has a certain amount of weight, even though in some instances he may be unconscious of it. In the case of the veterinary surgeon, when swine fever disappears he has still some other branch of his profession to fall back upon. Now, in a matter of this kind it would be inadvisable to move rashly, but I should like to suggest an experiment which I should divide into two parts. First, I would offer to the inspector of a district an honorarium as soon as swine fever has been cleared out, and I would also promise that as soon as his serviees were no longer required, that is, as soon as the disease had disappeared from his district, he should be appointed to some administrative civil service post, in which his salary, present and prospective, should be at least equal to that which he is receiving as an inspector. The second part of the experiment should be that no one other than a veterinary surgeon should afterwards be appointed to take charge of the purely veterinary and hygienic inspections in connection with the outbreaks of swine fever. It would not be necessary that he should be specially appointed, but he should be one of a departmental staff in the course of whose work the outbreak of swine fever would be a mere incident. Now that we have anthrax, tuberculosis, swine fever, and similar infective diseases to deal with, the importance of having a larger veterinary staff is becoming daily more evident. It may be objected that the standing cost would be heavy, but I am satisfied that it would be a mere fraction—first of all of what is being paid out for compensation, but, more important still, of the enormous

loss incurred through the ravages of diseases which are to a very great extent preventable. If we consider what was done in the case of contagious pleuro-pneumonia, where energetic and systematic measures were devised and carried out by skilled veterinary advisers and administrators, we cannot doubt that the same men would be capable of getting rid of swine fever.

"Another matter to which I should like to refer is the so far successful effort that has been made to get rid of rabies from our midst. It is not long ago that anyone advising systematic muzzling to be adopted for the purpose of stamping out rabies would have been laughed at as an enthusiast, and hooted down as cruel, and no Government would have dared to carry out the behests of such an individual. Some may say that it is the practical man who has brought this about. I do not agree with this; I hold that, curious as it may appear, Pasteur's researches on hydrophobia have been the means of rendering such a course as that recently adopted by the Board of Agriculture at all possible. Should there ever be another outbreak of hydrophobia, as there may be when the lessons of the last few years have been forgotten, I am convinced that no half-hearted localised measures will be adopted—every dog in the kingdom will be muzzled at once, and the result will be, that instead of taking two or three years to get rid of rabies, as has now practically been the case, there will not be a rabid animal left in the kingdom in six months. The Pasteur system for hydrophobia must remain in force and be of great value so long as there are rabid dogs in existence and so long as the disease can be transmitted by the wilder animals, but in civilised countries and in those where wolves do not exist universal muzzling will do away with any necessity for the Pasteur treatment. Scientific men do not wish to keep any special method of treatment in use after it is no longer required, and no one would hail the disappearance of the necessity for the use of Pasteur's, or any other inoculation, with greater delight than would medical and veterinary men.

"I want you to think over these subjects, gentlemen. When you go out into the world you will have your part to play in forming public opinion and in advising the course of action to be taken by those who rely upon you for assistance; and the more solid the foundation of your advice, the more it is based upon sound principles and scientific accuracy, the more readily will it be accepted by those for whose benefit it is offered. How markedly this applies to one of the questions of the hour—tuberculosis. Extremists of all kinds have had their say, each man, according to his interest or his predilections, has insisted upon or deprecated the importance of the various methods of spreading and preventing tuberculosis, and we are gradually coming to see that the spread of tuberculosis is not necessarily according to any one method, but that there are many forms of distribution. We have now got over what may be termed the time of panic. With the growth of our knowledge of the means of the spread of the disease has come light on the methods of prevention, and we are now even far more hopeful as regards treatment; but withal we have come to see that it is only by the co-operation of medical men, of veterinary surgeons, of public administrations, and of those who are interested in the raising of cattle and the supplying of milk, that we can gradually eliminate tuberculosis.

"One branch of this work, gentlemen, falls to your lot. You must bear some of the responsibility, and in return receive the thanks of the community when the work is done. You have, along with your medical brethren, to educate people up to the knowledge of the fact that tuberculosis is a specific infective disease; you have to point out that without the tubercle bacillus there can be no tubercle, but also to indicate that the tubercle bacillus may be present without giving rise to tuberculosis; you have to show that, common as the disease is, it is a preventable disease, and that the first thing to be done in preventing its spread is to find out the centres of infection, that being done

the battle is half won. It is for this reason that you are so thoroughly instructed in the use of tuberculin, by means of which, as is now recognised, the most latent forms of tuberculosis may be made out. You are to show the farmers that it is to their interest to have nothing but healthy stock; you have to prove to them that some of their stock *is* unhealthy, and that, quite apart from the danger that a tuberculous animal may be to the community, and quite apart from the fact that it is possible now and again to feed a tuberculous animal so that it may be disposed of at a fair market price, that he is dealing with a disease which may render it impossible, or at anyrate very uneconomical, to feed cattle for the market. The more serious aspect of the question—the danger to the public health—cannot be demonstrated to the farmer in the same way as the less serious aspect can, and therefore he is not so ready to receive it; but once let him be convinced on either point, and I am satisfied that there will be little difficulty in prevailing on him, first of all, to submit his animals to the tuberculin test, and, secondly, to place them under such conditions that the danger of spread of tuberculosis may be considerably minimised.

"I am speaking to you now as veterinary surgeons. If I were addressing an audience of medical men, I should have to point out other and perhaps even greater or more important methods of the spread of the disease, and I should have to insist upon other methods of prophylaxis and treatment; but it is only by each one doing his part, and all working towards a common end, that we shall ever be able to get rid of, or reduce to a minimum, the fearful scourge now raging in our midst—tuberculosis.

"Gentlemen, I wish you a pleasant and instructive year, and I believe that you can have that in one way, but in one way only. Keep a sound mind in a healthy body. Health is one of the greatest gifts God has given to us. Without it the best trained mind cannot do its best work. To you, one and all, I say, Do not loaf; work whilst you are at work; but when you have finished, and feel that you have done your duty, play your very hardest, and apply practically in your own case those physiological laws concerning muscular action, respiration, and nutrition, by means of which mind and body may be kept in a condition that will enable you to give of your very best to yourselves, your patients, and the community."

Professor Woodhead having resumed his seat amid prolonged applause, Mr Swithinbank, one of the Governors of the College, who had taken the Chair (Colonel Duck having been obliged to leave the meeting), called on Sir Ernest Clarke, Secretary to the Royal Agricultural Society, to move a vote of thanks to the lecturer.

Sir Ernest Clarke said that there was one phrase in the instructive address to which they had just listened to which he would like to call the attention of the Principal of the College, namely, that persons who had only a capacity for administrative and secretarial work should be kept to their proper duties, and should not be called upon on occasions such as that to discourse on scientific matters. If that rule had been observed he would not on that occasion have been called on to say anything. He had hoped that Sir George Brown would have been present, as representing the older school of veterinary science, to welcome the distinguished representative of the newer school of veterinary science, Professor Woodhead. He was unfortunately absent, and Professor M'Fadyean, at a moment's notice, had called upon him (Sir Ernest Clarke) to move a vote of thanks to the lecturer. Professor Woodhead in his address had said a good deal about practice and science, and he would like to beg the students, throughout their whole professional career, to keep the force of these two pregnant words in mind. By-and-bye they would constitute the scientific men to whom the agriculturalists of the future would have to look for professional care of their flocks and herds, and especially for advice regarding the prevention of disease

amongst their animals. The Royal Agricultural Society, with which he had the privilege of being associated, had from the very beginning assisted that College, and the College in turn had lent assistance to the Royal Agricultural Society. He endorsed the excellent advice which had been offered to the students, and he moved that they should return to Professor Woodhead a hearty vote of thanks for his trouble in coming there that day. Professor Woodhead had first made his name at Edinburgh, and he next came to London, where he made a still greater name. He had now gone to Cambridge, and they trusted that he would there add still further to his fame. They wished him all possible success and prosperity in his new career of usefulness at Cambridge (cheers).

The CHAIRMAN having formally put the motion it was carried with acclamation.

The CHAIRMAN then called upon the Principal to read the list of prizes competed for during the previous Session.

PROFESSOR M'FADYEAN, the Principal, in reading the prize list (*see* last number, p. 274) said it included one new and important feature. The Governors of the College had always been deeply impressed with the great importance of the clinical part of the student's education, and as a further incentive to clinical study they had resolved during the past Session to institute a new series of clinical prizes for competition in each of the four classes. The competitive examinations for each of these prizes were entirely oral and practical, and the result had been very satisfactory. In justice to the students who had competed during the past year he thought he ought to say that the session had been a remarkably successful one. Of the total number of students who presented themselves for examination in July, 73 per cent. passed.

SIR NIGEL KINGSCOTE, who rose to move a vote of thanks to the Chairman, said that they must all have regretted that Colonel Duck was unable to stay until the end of the proceedings. Speaking as a Governor of the College, he said that they desired to express their thanks to Colonel Duck for coming there to preside on that occasion, and for the interest which, as Director-General of the Army Veterinary Department, he took in the Royal Veterinary College. He had no doubt that had Colonel Duck remained he would have told them that within recent years there had been a great improvement in the quality of the men who joined the Department. He did not think that it was casting any slur on the older members of the profession to say so, but merely recognising the advantages of recent improvements in veterinary education. He entirely agreed with what Professor Woodhead had said regarding the importance of practice, and he thought they might claim with some pride that a great amount of attention was now paid to the practical side of their education at that Institution.

There was one other matter touched upon by the lecturer that he would like to refer to, namely, swine fever. He did not wish to say anything disrespectful of those inspectors already appointed in connection with the disease, but surely it was only common sense that work of that kind should be intrusted to veterinary surgeons. He believed that in the near future the public would demand that the inspection of markets, and all inspections of animals, whether dead or alive, should be intrusted to veterinary surgeons, and in this way a considerably wider field of work for the profession would be opened up. In conclusion, he begged to move a hearty vote of thanks to Veterinary-Colonel Duck, and to Mr Swithinbank for having taken the chair in his absence.

MR SWITHINBANK having briefly replied, the proceedings terminated.

PRINTED BY W. AND A. K. JOHNSTON, EDINBURGH AND LONDON.

INDEX TO ILLUSTRATIONS IN VOLUME XII.

INDEX TO ARTICLES IN VOLUME XII.

INDEX TO AUTHORS IN VOLUME XII.